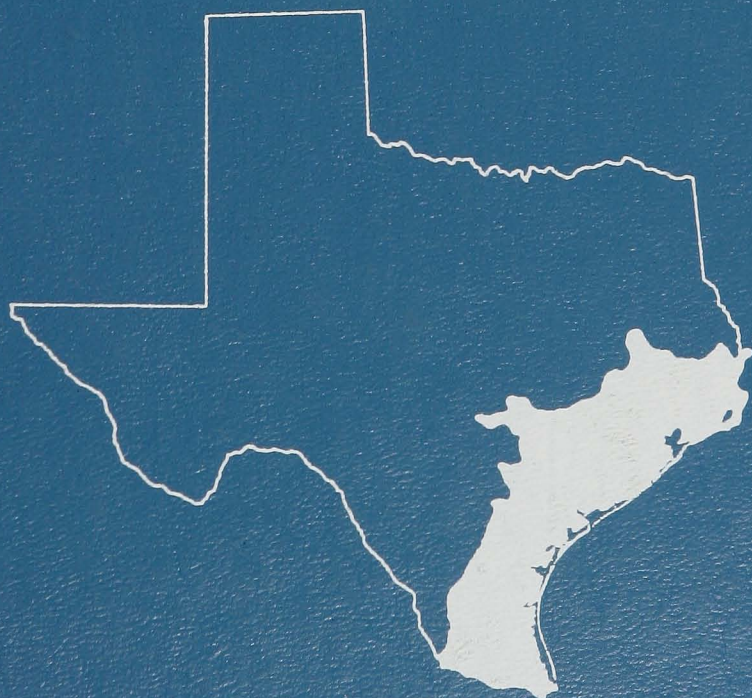
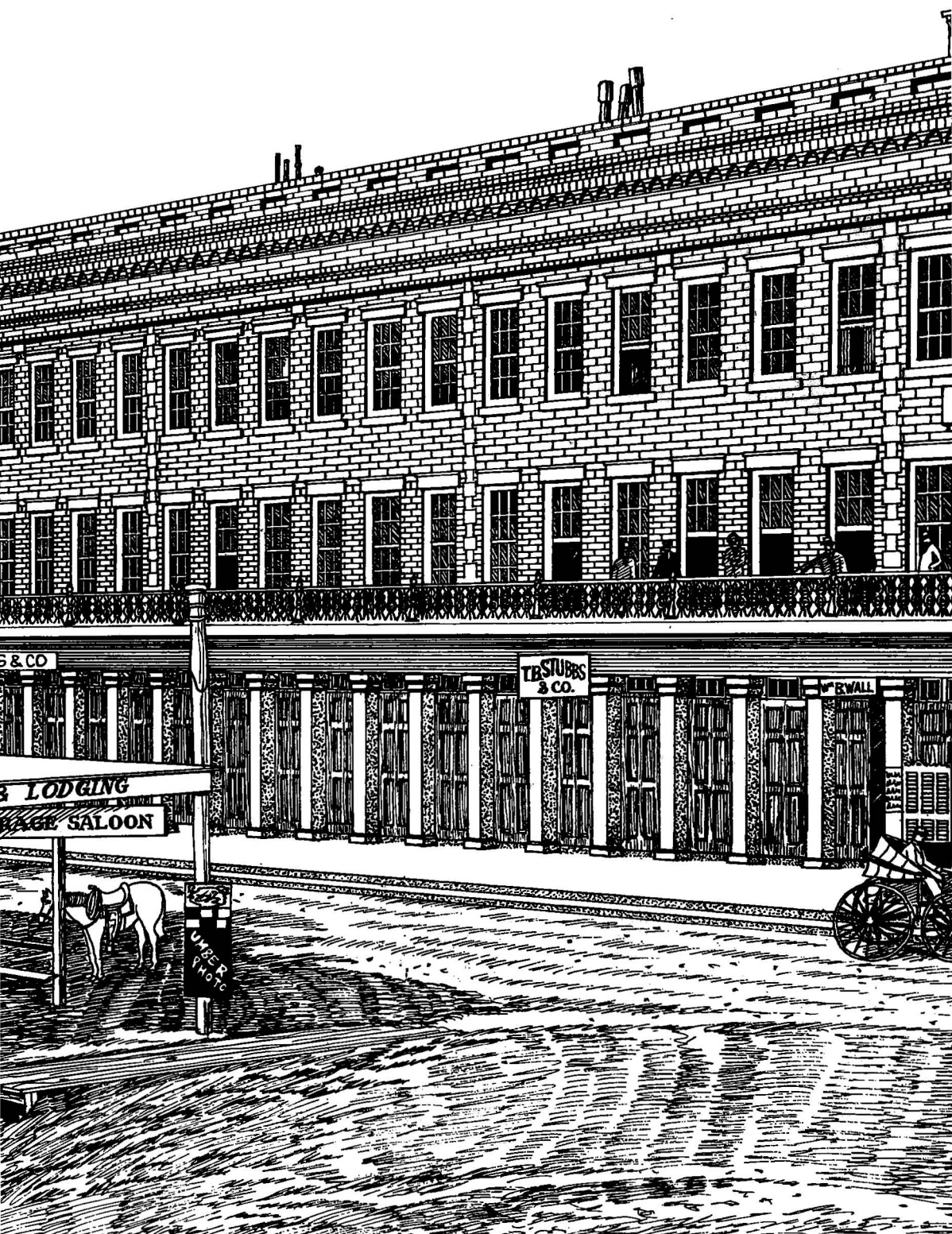
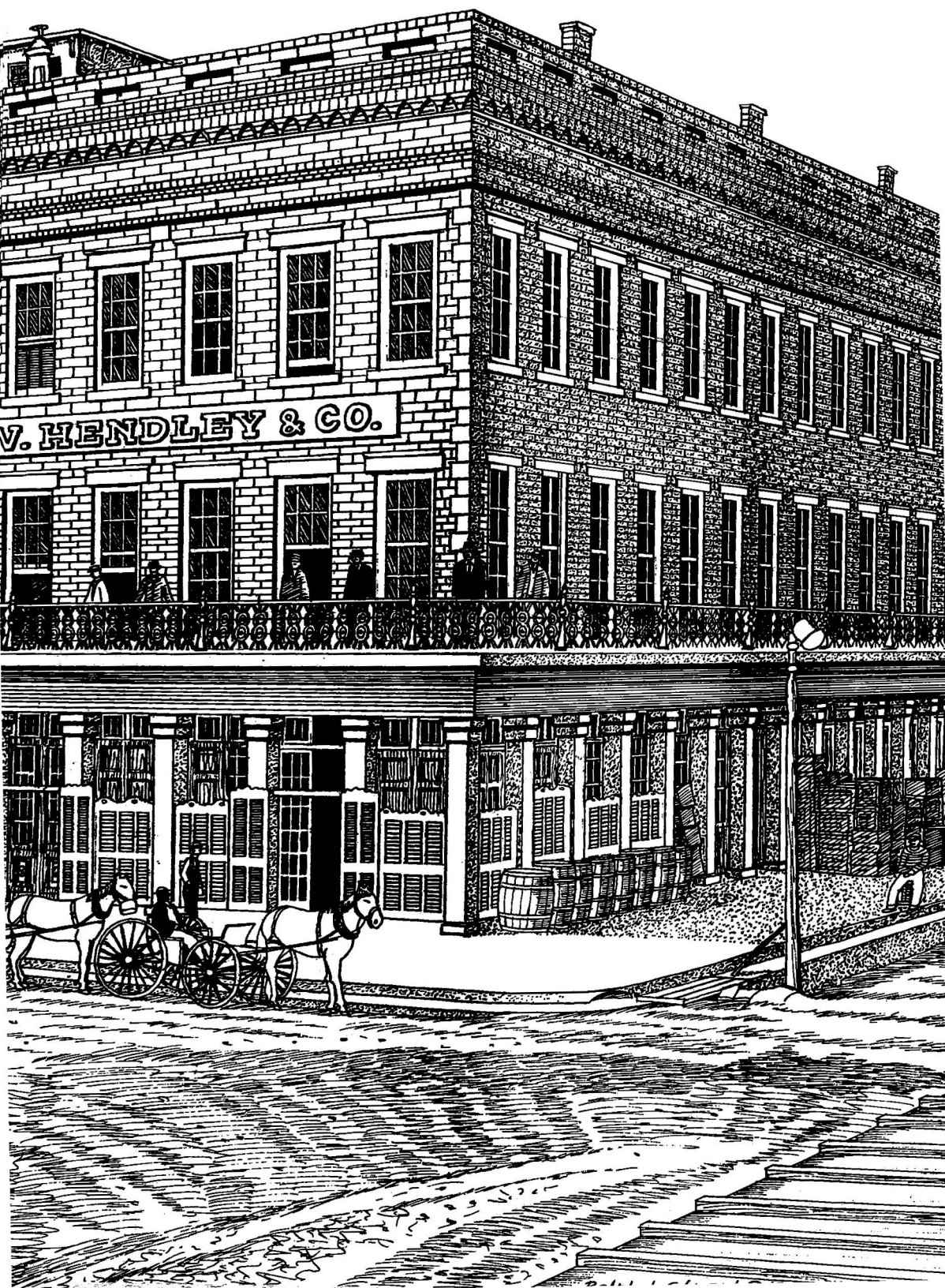


Custodians of the Coast



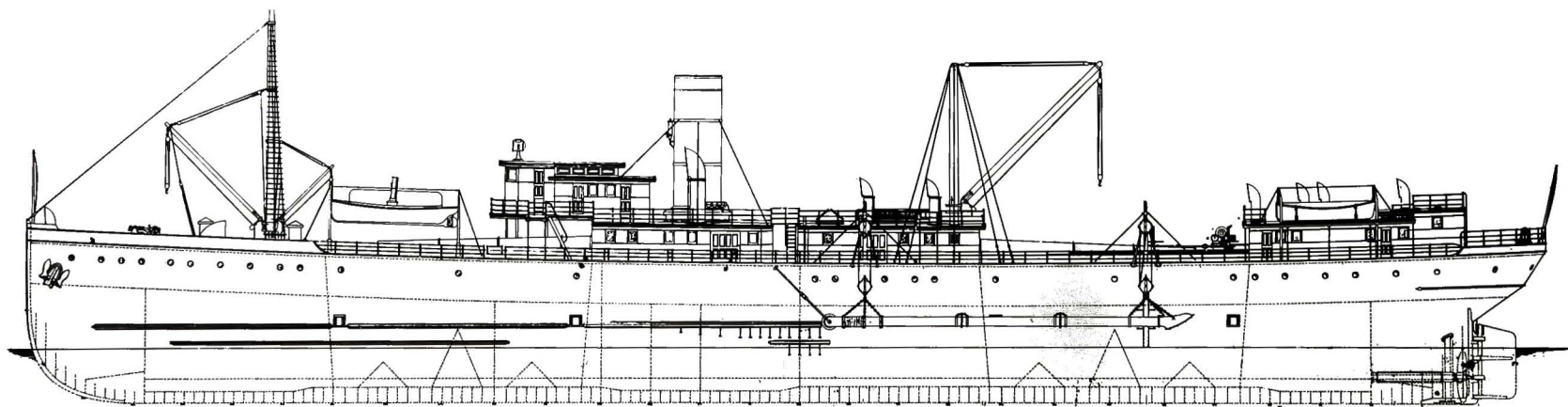
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Line drawing of Hendley Building by Ralph L. Stuart
Courtesy of Port of Galveston Magazine

Custodians of the Coast



Outboard profile of U.S. hopper dredge Galveston, 1908

Custodians of the Coast

HISTORY OF THE
UNITED STATES ARMY ENGINEERS
AT GALVESTON

by Lynn M. Alperin

GALVESTON DISTRICT
UNITED STATES ARMY CORPS OF ENGINEERS
GALVESTON

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Foreword

The record of the Army Corps of Engineers at Galveston is a history of the waterways in Texas. Because this story has been largely neglected, *Custodians of the Coast* represents an initial attempt to document Corps activities in the development of the Texas coastal region. Hopefully, it will convey to the reader some sense of what the Galveston District was and is.

As the story unfolds, it describes the relation between the army engineers and residents of the Texas Gulf Coast. Cooperation between the Corps and local citizens stands out as early as the first decade of the Galveston District's existence. In 1883, under authorization of the Texas legislature, the city issued bonds to raise money that was turned over to the engineer in charge to carry on the federal navigation project when Congressional appropriations failed. This spirit of cooperation has continued through to the present day.

This book, then, tells the story of the men and women of the Corps of Engineers at Galveston working together with citizens of the Texas Coast to develop and protect that coast. The collaborative efforts of these groups has led to accomplishments in which all concerned may take pride.

Jon C. Vanden Bosch
Colonel, Corps of Engineers
District Engineer

The Author

Lynn Manaster Alperin holds Bachelor of Arts degrees in liberal arts from the University of Chicago and in English literature from Goucher College in Baltimore. Her professional activities include writing, editorial, research, and public relations experience in the fields of medicine and industrial relations. A native of Chicago, Mrs. Alperin has lived in Galveston the past fourteen years.

Acknowledgments

Producing this history has proved a challenging, unexpectedly exciting, and immensely rewarding endeavor. My task would have been virtually impossible, however, without benefit of widespread assistance. Were I to single out a *sine qua non*, it would surely be the support I have received from Albert B. Davis, whose constant enthusiasm and considerable knowledge have been invaluable. He has been a patient mentor, guiding me through intricacies of engineering detail and explaining seemingly inextricable pieces of information. His critical review of the first draft is in great measure responsible for technical accuracy in the narrative. I am enormously grateful to him for faithfully continuing to share his expertise and maintain his interest in this project since his retirement in 1975.

I was especially blessed with the services of Polly A. Young, who did far more than type the manuscript and proofread galleys with me. I shall be ever thankful for her accomplished skills, unfailing good humor, meticulous attention to detail, and enthusiastic dedication to the undertaking. Niels A. Nilson generously satisfied my need for honest and thoughtful criticism, spending many hours reviewing drafts at each stage of revision. He deserves credit for much of what is coherent and concise in the final narrative and I am deeply indebted to him for performing this tedious, but indispensable, chore.

From the Engineer Historical Division in Baltimore, Dr. Jesse A. Remington offered inspiration and guidance of which I freely and gratefully availed myself. I was fortunate also in receiving professional assistance from Dr. Albert E. Cowdrey, Lenore Fine, and Dr. Charles E. Walker. The revisions suggested by Dr. Cowdrey aided me immeasurably in making needed editorial improvements.

The visual merits of this book are largely due to the efforts of Larry C. Dunaway, who processed negatives for all the artwork, and to Gilbert Trevino, who redrew and adapted the many maps and illustrations that were unsuitable for reproduction as they were. John A. Heckendorn executed the cover design and Patricia J. Hughton assisted also with the illustrations.

Without exception, employees throughout the district spared no effort to root out information and answer my questions. Those kind enough to review selected portions of the drafts included: Thomas W. Anderson, John C. Batey, Vernon E. Bennett, Robert W. Brinegar, William P. Hamblen III, Victor C. Keesecker, Ronald H. Nelson, Chester Pawlik, Jonathan L. Ransom, Warren K. Smith, and Ernest H. Wittig III. Kenneth B. Bonham, Ronald C. Geasland, and Marion B. Lee read most

of the first draft. Michael B. Hughes cheerfully undertook responsibility for proper citation of legal references under the guidance of William A. Hough.

Countless other individuals helped. As a bewildered stranger to the Corps, I greatly appreciated the guidance and assistance offered by district librarian Mildred R. West, Paul C. Wilson, Jr., and the late Edward A. Rogers. Vivian J. Miller dug out materials I needed and would have never known existed. Personnel in the Office of Administrative Services welcomed me warmly into their midst and assisted in innumerable ways. Responsible for administering my contract, Ron Geasland earned my sincere gratitude by providing cooperation far beyond the call of duty. Ken Bonham helped me select photographs of various district projects and William Arteaga furnished valued advice and assistance on artwork. E. Elsie Southerland provided generous and efficient help in completing the index. Franklin E. Beal took me on a memorable tour of the Brownsville area and Donald E. Driggs helpfully showed me the hurricane-flood protection at Texas City. Diane Huber assisted with proofreading and other chores at the last minute. Betty G. Manaster also reviewed the galley proofs.

Former personnel of the Galveston District contributed vital information. These gentlemen graciously shared their knowledge and recollections with me, filling in many gaps where documentary evidence left off. I am particularly grateful to Edwin A. Pearson, without whom I would have had considerable difficulty reconstructing the district's military history. He accorded a high priority to this task and made himself available to furnish much of the essential structure and detail for the chapter on military works. Other former employees who provided glimpses of the past were Charles F. Baehr, Jack F. Beck, Norman W. Brown, Glen F. Egan, the late Thomas W. Forman, Howard L. Heald, the late Darrell L. Jackson, Wilbur E. Laird, H. R. Norman, William C. Rettiger, M. R. Royar, Herbert E. Schmidt, Jack M. Simpson, J. Bruce Walters, E. A. Weiser, and Wylie H. White.

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Darst of Galveston College kindly shared materials from his personal collection of local historical documents. Emery A. Dilda and Howard D. Duckett of the Government Printing Office in Dallas provided invaluable typographic and printing expertise. Thanks go also to Louise Carver for her careful preparation of the index.

The many other district employees who responded to my requests and who exhibited interest in the progress of this history helped more than they will ever know. To them and to all those who contributed, but who are too many to enumerate, I am truly grateful. Although their names do not appear here, I hope they will gain satisfaction from recognizing their contributions in the book.

Finally, I wish to express my thanks to the members of the district historical committee for giving me the opportunity to produce their history. No less deserving of thanks are my husband, Jack, and son, Bruce, who have endured my preoccupation with this project with understanding and forbearance.

For the sake of readability, I have necessarily sacrificed considerable detail. Ideally, these omissions will serve to stimulate historians to pursue more specific research in the future. For errors in fact or interpretation that may appear, I claim sole responsibility.

L. M. A.



Introduction

The appearance of Galveston from the Harbour is singularly dreary. It is a low flat sandy Island about 30 miles in length & ranging in breadth from 1 to 2. There is hardly a shrub visible, & in short it looks like a piece of prairie [sic] that had quarrelled with the main land & dissolved partnership.¹

Despite this rather inauspicious appraisal rendered in the year 1840, Galveston Island somehow managed to flourish. The city that grew up on its barren shores became a focal point in the historical development of Texas and the greater Southwest.

During the first decade of the nineteenth century, Galveston Island had been a virtual wilderness, inhabited by cannibalistic Karankawa Indians and seething with rattlesnakes and other unappealing forms of wildlife. The Texas Coast abounded with freebooters and privateers. Jean Lafitte, a notorious pirate, established a commune on the east end of Galveston Island in 1817. From this base of operations, he spent the next four years profitably raiding Spanish ships sailing in the Gulf of Mexico. The period of filibustering came to an end in 1821 when Lafitte made the mistake of attacking an American vessel and President James Monroe ordered him out of Galveston.²

The permanent settlers who followed entertained grand dreams for their city. Blessed with the finest natural harbor on the Gulf west of the Mississippi, Galveston offered promise of becoming the "Queen of the Gulf." Creation of the Texas Republic in 1836 gave rise to an active port, destined to enjoy a prominent role in commercial development of the burgeoning region.

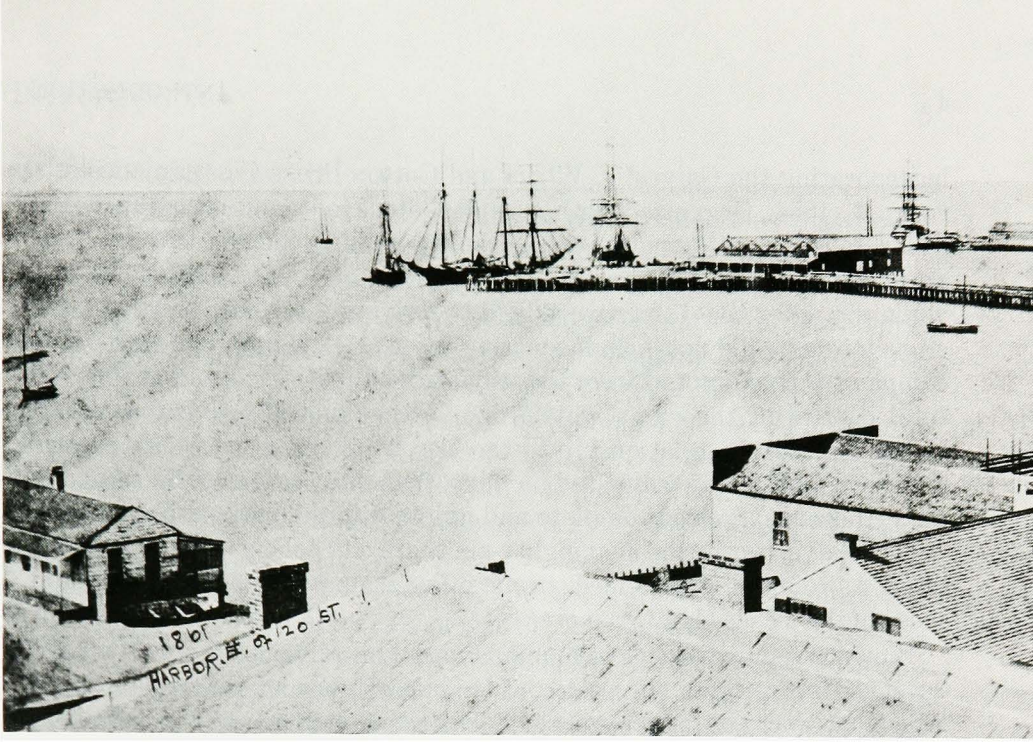
Commodore Charles Morgan opened the Texas Gulf Coast trade. His first vessel, the *Columbia*, steamed into Galveston Harbor on November 25, 1837, initiating regularly scheduled packet service. By March of 1838, over seven hundred passengers had been transported aboard the *Columbia* the 375 miles from New Orleans to Texas. The thirty-six-hour voyage afforded elegance which contrasted sharply with the crude conditions encountered upon disembarkation at Galveston. One early passenger praised the vessel, impressed by "the finest and whitest linen," the attendance of "a lady-like chamber maid," and dining with silver forks and ivory knives at meals prepared by a French cook and served by "curly-headed, rosey-cheeked [sic] Irish waiters."³



Immigrants arriving at port of Galveston (Rosenberg Library)

Michel B. Menard, a French-Canadian fur-trader, and his associates purchased from the young Texas Republic a "league and labor" of land on Galveston Island for the sum of \$50,000. This transaction, begun in 1834, was finalized in January, 1838. Menard proceeded to lay out the city and to organize the powerful Galveston City Company. Improvement and expansion of the port quickly rose high on the list of necessary priorities; toward this end, Menard and his colleagues donated valuable waterfront property to reputable businessmen who would agree to erect wharves there.⁴

Two prominent merchants, Samuel May Williams and Thomas F. McKinney, moved their business to Galveston. Both had been members



Galveston Harbor in 1861, looking east from Twentieth Street (Rosenberg Library)

of the “Old Three Hundred,” the original families in Stephen F. Austin’s settlement dating back to 1824. These early Texas pioneers spearheaded port improvements at Galveston. Williams and McKinney began constructing the first permanent wharf at the foot of Twenty-fourth Street and the Strand in 1838, the same year the port of Galveston was opened officially; Gail Borden, who later gained fame for his invention and manufacture of condensed milk, became the first customs collector. By the following year, six steamers were commuting regularly from Galveston to Houston and from Galveston to New Orleans. Activity bustled along the waterfront and the port handled commerce exceeding \$1 million in value during 1839. Cotton quickly established its preeminence as Galveston’s chief commodity. As a port of entry, the city received waves of immigrants, many of whom chose to remain, adding to the proliferating population of over three thousand and contributing greatly to the city’s business and economic life. By 1840, Francis Sheridan, an Irishman in the British diplomatic service, had visited Galveston and described the wharf of Williams and McKinney as “the only interesting spot in Galveston.”⁵

Early in 1854, Colonel Menard called together the individual owners of waterfront facilities to consolidate the properties and to place their operation under a single management. The Texas legislature issued the charter

incorporating the Galveston Wharf and Cotton Press Company on February 4, 1854. Organized with a capital stock of about \$1 million, the Galveston Wharf Company (as it became popularly known) was set up in an unconventional fashion. One-third of its stock was held by the city while the other two-thirds were held by private interests; however, the city's interests did not include a voting voice. As a semipublic entity, the company was exempted from the usual tax obligations, while it enjoyed total control of the city's waterfront. Although the Galveston Wharf Company's future relationship to the city would be stormy, its control criticized and legally contested on more than one occasion, the company nevertheless exercised complete and uninterrupted domination over the port of Galveston for the next eighty-six years. Its policies would, further, exert a profound and, indeed, ironic influence on the eventual development of the Texas Gulf Coast.⁶

Blocking immediate development were the physical features of the coast. Offshore lay a succession of long, narrow sand islands, between which entrances or passes emerged. The major streams of Texas flowed, largely parallel to one another, from northwest to southeast; most emptied into large bays or lagoons which were located behind the chain of barrier islands. These bays formed tidal reservoirs, into which waters from the Gulf of Mexico ponded daily during flood tide and from which they were discharged through the passes during ebb tide. The scouring effect of these currents afforded navigable depths at the passes between the islands. At the inner ends of the passes, the channels vanished as the force of the flood tide current dissipated in the shoal waters of the bays; at the outer ends, bars tended to form as the passes expanded and the ebb tide current lost its eroding effect. These bars often obstructed entrance to the channels from the deep water of the Gulf.⁷

Such was the case at Galveston. The geographical fact of two troublesome sandbars stood between the ambitious wharf company and deep-water port expansion. Almost from its beginning, the city sought deeper water, but financing and engineering problems stood in the way. The solution to the harbor difficulties would come ultimately from the United States Army Corps of Engineers.

By the time it addressed the problems in Galveston Harbor, the Corps of Engineers was a well-established organization with a history dating back to the American Revolution. On June 16, 1775 — the day before the Battle of Bunker Hill — the Continental Congress had passed a resolution providing for one chief engineer and two assistants to serve in the army. When Gen. George Washington assumed command of the Continental army in July, he appointed Richard Gridley, formerly an officer in the

British Colonial army, to serve as chief engineer of the army and chief of artillery. Gridley directed construction of the fortifications that finally forced the British evacuation of Boston in March, 1776.⁸

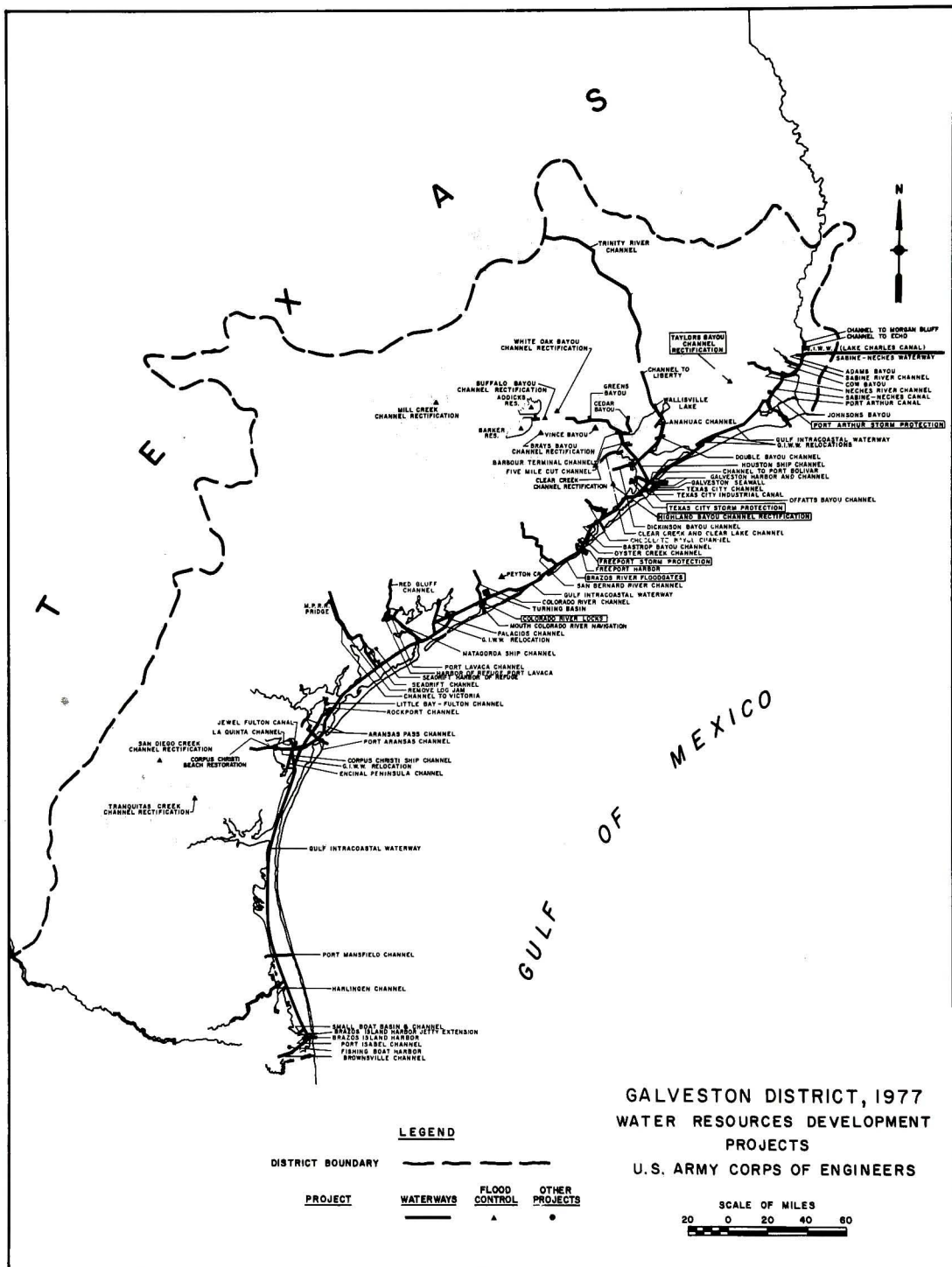
Gridley's assistant in the earlier French and Indian War, Rufus Putnam, accompanied Washington when he moved his army to New York, while Gridley remained to safeguard the New England Coast. In August, 1776, Putnam was appointed chief engineer; however, because Congress refused to authorize an engineer corps, he relinquished his commission as an engineer in December. A "Corps of Engineers" under the command of Frenchman Brig. Gen. Louis DuPortail was formally established in 1779, but was also short-lived, being disbanded after the Treaty of Paris in 1783.⁹

Events of the French Revolution and the war between France and England raised potential threats of war to the young American nation. In 1794, at the urging of President Washington, Congress established a Corps of Artillerists and Engineers to develop a system of seacoast fortifications. This body was abolished on March 16, 1802 by legislation creating the engineer organization that has endured to the present day.¹⁰

At first, the new Corps of Engineers "constituted a military academy" at West Point. Superintended by engineer officers until 1866, the military academy pioneered engineering education in America and for twenty-two years was the only such school in the country. Up until the Civil War, West Point graduates staffed other institutions as technical training became more widespread. Meanwhile, responsibilities of the Corps were expanded to include many civil as well as military works.¹¹

The format for civil works activities developed through an arrangement of local engineer offices (later called districts), each under the direction of an army engineer officer. In 1880, a U.S. Army Engineer Office was established on Galveston Island. Known today as the Galveston District, this headquarters was designated in earlier years as the "Galveston Engineer Office" and the "U.S. Engineer Office." At various times, both the district office and its parent organization, the Corps of Engineers, have been referred to as the "Engineer Department."

The first district engineers reported directly to the chief of engineers in Washington, D.C. In 1888, the Corps of Engineers decentralized, interposing a divisional level between the chief and the district offices. Initially placed under the authority of a Southwest Division engineer headquartered in New York, the Galveston Engineer Office was later transferred to a Gulf Division and Gulf of Mexico Division in New Orleans, and eventually, in 1941, to the present Southwestern Division located in Dallas.¹²



Over the years, the Galveston District has responded to changing times and fluctuating national priorities. Vicissitudes of political climate, economic development, foreign relations, and social awareness together with regional topographic, geographic, climatic, commercial, and agricultural features have molded its unique history. A continuous program of civil works undergirded the activities of the Galveston army engineers, while for sixty-five years a military mission added another dimension to their work.

Boundaries of the district have undergone numerous revisions. Originally responsible for river and harbor improvements in the entire state of Texas, the Galveston District grew to encompass parts of Louisiana, Arkansas, Oklahoma, and New Mexico. Military boundaries, distinct from civil boundaries, included all of Texas at one time or another plus the lower portion of Louisiana. Today, the district performs a civil function in the coastal region of Texas, bounded by the Rio Grande on the west and the Sabine River on the east.

The men and women of the Galveston District have made substantial and lasting contributions to the settlement, development, and safety of the area they have served. This is their story.

Notes to Introduction

¹. Francis Sheridan, *Galveston Island: The Journal of Francis C. Sheridan 1839-1840*, ed. Willis W. Pratt (Austin: University of Texas Press, 1954), p. 32.

². Conflicting accounts may be found that suggest Lafitte left voluntarily as diversion of Spanish trade made his operation less profitable and a severe hurricane decimated his settlement.

³. James P. Baughman, *Charles Morgan and the Development of Southern Transportation* (Nashville: Vanderbilt University Press, 1968), pp. 21, 24-27.

⁴. A league, or sitio, was a common measure in which land grants were parceled out, amounting to roughly 4,428 acres or an area about a mile and one-third square. A labor was composed of 177 acres. Louis J. Wortham, *A History of Texas*, 5 vols. (Fort Worth: Wortham-Molyneaux Co., 1924) 1: 412; Paul R. McGuff and Mary M. Ford, *Galveston Bay Area, Texas: A Study of Archeological and Historical Resources in Areas under Investigation for Navigation Improvement*, Texas Archeological Survey, Research Report no. 36 (Austin: University of Texas, 1974), pp. 25-26; "Port of Galveston's History Colorful," *Port of Galveston* (June 1968), p. 21.

⁵. Wortham, *History of Texas*, pp. 421, 426; McGuff & Ford, *Galveston Bay Area*, p. 26; "Galveston's History Colorful," p. 21; Sheridan, *Galveston Island*, p. 50.

⁶. E. L. Wall, ed., *The Port Situation at Galveston* (Galveston: Galveston News Co., 1928); Earl Wesley Fornell, *The Galveston Era: The Texas Crescent on the Eve of Secession* (Austin: University of Texas Press, 1961), p. 16.

⁷. *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1871* (Washington, D.C.: Government Printing Office, 1871), p. 518.

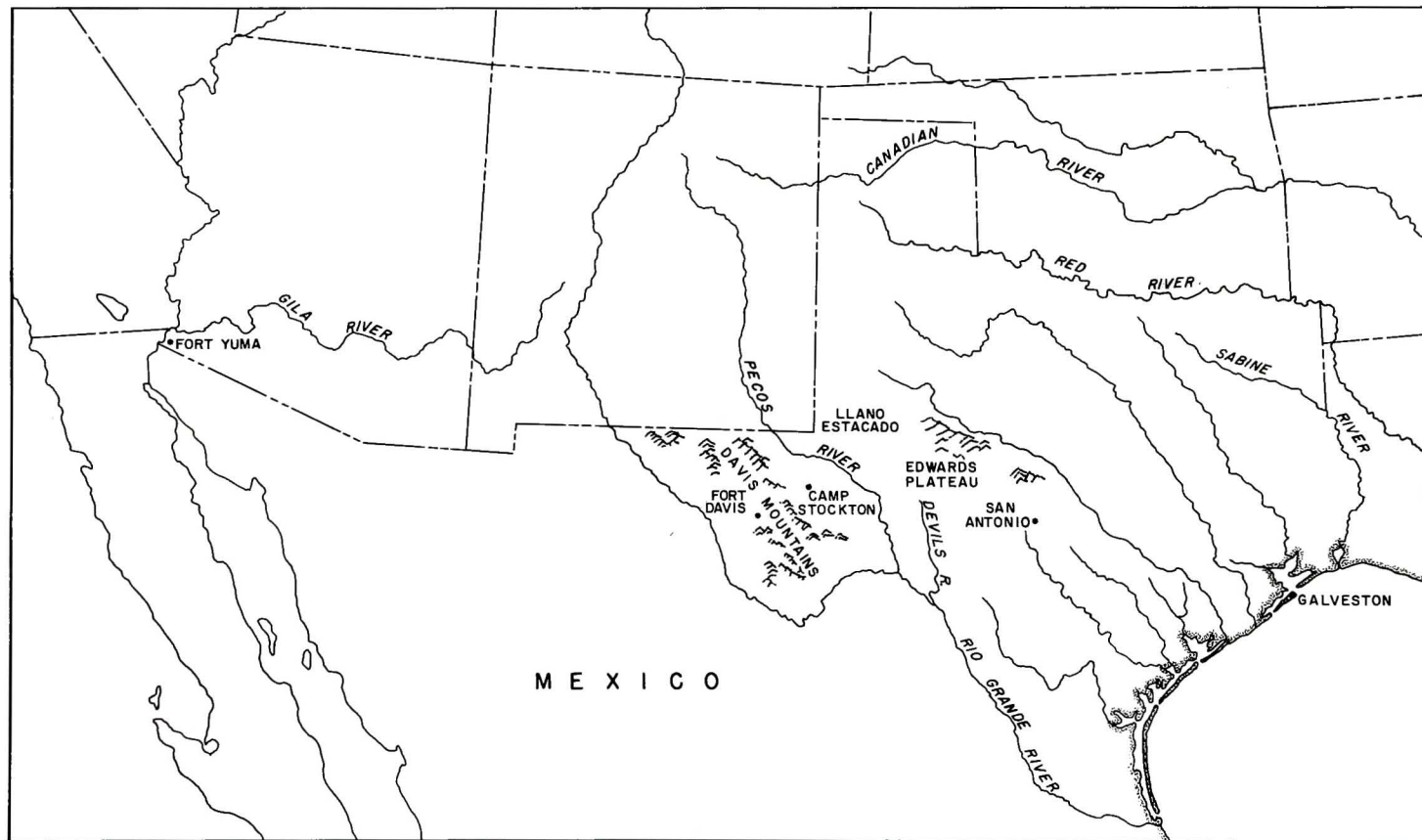
⁸. *Geneses of the Corps of Engineers* (Fort Belvoir, Va.: Corps of Engineers Museum, 1966), p. 2 (hereafter cited as *Geneses*).

⁹. *Ibid.*, pp. 2-3.

¹⁰. *Ibid.*, p. 3; Forest G. Hill, *Roads, Rails & Waterways: The Army Engineers and Early Transportation* (Norman: University of Oklahoma Press, 1957), p. 5.

¹¹. *Geneses*, p. 7.

¹². Adjutant General's Office, General Order (GO) 93, 8 November 1888; Corps of Engineers, GO 12, 3 December 1888; Office of the Chief of Engineers, GO 8, 16 December 1940.



Army Engineers and Western Expansion

The story of the Galveston army engineers fits into the larger saga of the American Southwest. In exploring and developing this vast, arid region, man encountered many hardships, not the least of which was the absence of water. Availability of this precious element was crucial to the success of any undertaking. Galveston offered the natural resources to provide a desperately needed Gulf Coast outlet; the Corps of Engineers possessed the technical expertise and experience. Such were the circumstances that eventually led the army engineers to Galveston Island.

The engineers' story really begins in 1802 with establishment of the Corps of Engineers and the military academy at West Point. Initially, this arm of the United States Army responded to the country's pressing need for trained engineers and for an adequate network of coastal defense. During the ten years prior to the War of 1812, army engineers directed their attention almost exclusively to the military school and to fortifications along the more densely populated eastern seaboard.

In the course of their work on harbor defenses, the early engineers surveyed estuaries and rivers, gaining data that proved useful to seamen and port officials. The value of applying such information to civil improvement and national development soon became obvious, leading to creation of a Topographical Bureau in the Engineer Department by 1818. Eleven years later, Col. John J. Abert assumed leadership of this bureau. In 1838, Congress established the enlarged Corps of Topographical Engineers, directed by Abert throughout all but the last two of its twenty-five-year existence; his counterpart in the Corps of Engineers during these years was Chief Engineer Maj. Gen. Joseph G. Totten.¹

The appropriate function for the army engineers provided a subject for considerable debate. Opinions varied as to the proper nature and extent of federal government involvement in internal improvements. The General Survey Act, passed in 1824, formalized the introduction of army engineers into civil engineering and set up a format for using their scientific skills in making surveys, plans, and estimates for roads and canals which merited national support. With the government surveys for the Baltimore & Ohio Railroad in 1827, canals began to relinquish their priority to the railroads. Construction of lighthouses gradually gained importance along with western roads and other projects such as beacon lights, monuments, bridges, and aqueducts. Surveying for river and harbor improvements

expanded steadily. Finally, the profusion of surveys for roads, canals, and railroads gave way to military and geographical surveys of coastal, geological, and mineralogical features. Military field work increased rapidly and efforts were directed toward examination of the natural frontiers and surveys to determine political boundaries.

With repeal of the General Survey Act in 1838, civil constructions of the Topographical Bureau were augmented by the transfer of all such works previously directed by the Corps of Engineers. Having acquired its status of a full-fledged corps, the new Corps of Topographical Engineers entered into activities that would constitute one of the most colorful chapters in the history of the American West.

The Texas Frontier

From 1824 to 1838, while the topographical engineers were emerging as the nation's surveyors and explorers, Texas was undergoing dramatic changes. Settlement had become the new order of the day. Mexico (which included Texas) had won its independence from Spain in 1821. Up to that time, Texas had but three permanent settlements and a population estimated at no more than 7,000. With land granted by Mexico, Stephen F. Austin began colonizing Texas. As the Anglo population increased, Mexico began to toughen its policies on the new settlers. The result was the War of Independence and creation of the Texas Republic in 1836. The call to arms had reached out to distant points and attracted an influx of heroic men, many of whom remained to augment the Texas population which numbered between 35,000 and 50,000 at the outbreak of the war. During the years of the republic, the population continued to climb; when the United States annexed Texas in 1845, the estimated population was between 125,000 and 150,000.

If the interest of the army engineers in Texas had been formerly casual, annexation quickly corrected this oversight. The eyes of the nation turned on Texas, which suddenly found itself in the federal limelight. Both military and civil needs demanded the attention and expertise of the well-schooled officers of the Topographical Corps.²

The most pressing concern was the military situation. Defenses were needed against the chronic threat of the Indians and, of perhaps greater urgency at that moment, against the Mexicans who were refusing to acknowledge Texan independence. Attempts at diplomacy with Mexico proving futile, President James K. Polk decided to resort to arms to maintain the Texas border at the Rio Grande.

Despite its sudden involvement in Texas, "the American general staff was singularly ignorant of Southwestern geography."³ The task of cor-

recting this deficiency was a natural one for the topographical engineers. Although promoted by the diplomatic crisis with Mexico, several expeditions launched in 1845 concentrated on gathering scientific information about the unknown country. This intelligence proved useful to military strategists and settlers alike. As annexation became imminent and diplomatic relations with Mexico further deteriorated, Colonel Abert sought greater knowledge of the Texas geography.

Command of the first Texas expedition fell to the colonel's own son, fledgling Lt. James W. Abert. His assignment was a reconnaissance of the territory of the Comanche and Kiowa Indians, crossing the Llano Estacado (Staked Plains) in northwest Texas, and traveling east along the Canadian River.⁴ The party set out from Colorado in mid-August, equipped with only a sextant and chronometer. Much of Abert's march through the Comanche Territory was accompanied by the sound of war drums, undoubtedly causing the explorers considerable consternation, but they were never attacked and arrived safely in the Arkansas Territory late in October. Along the way, the officers collected flora and fauna, gathered geological data, and noted the mineral resources of the region.

The young Lieutenant Abert succeeded in his scientific quest by providing the first trustworthy representation of the Canadian River region of North Texas. He scored another first in providing the federal government valuable descriptions of the Indians. Although the information he furnished contained many implications for settlement, it was more immediately utilized for military purposes.

When the War with Mexico broke out in May of 1846, the topographical engineers plunged into combat duty, which they combined with their instinctual acquisition of scientific information. Although their mapping activities were largely confined to Mexican soil, they experienced firsthand the practical problems to be reckoned with in the unfamiliar environment of the Southwest; further, they developed an appreciation for the vital importance of water to any future enterprise that might be planned for the area.

The Treaty of Guadalupe Hidalgo, signed February 2, 1848, brought to an end the Mexican War and transferred to the United States ownership of a huge expanse of western land, but failed to delineate the exact line of the border between the two countries. The vague boundary specified in the treaty encompassed many points of strategic importance.

This ambiguity led to a survey of the boundary between the United States and Mexico, the first large-scale project undertaken by the topographical engineers in the Southwest. The bitter conflict that arose over this boundary was finally resolved by the Gadsden Treaty of December 30, 1853, through which the United States purchased land that could be

used for a southern railroad route along the thirty-second parallel. Maj. William Hemsley Emory, as commissioner and chief astronomer, surveyed the Gadsden Boundary from December, 1854 through October, 1855. By January, 1857, official maps had been drawn, reports submitted to Congress, and the field records of the Mexican Boundary Survey were closed. The expedition yielded valuable geological information, the largest botanical survey to date, extensive zoological classification, and knowledge of the Indian tribes of the Southwest.

Article XI of the Treaty of Guadalupe Hidalgo had explicitly assigned the United States Army responsibility to defend the frontier against the Indians. Maintenance of this military frontier, which extended west from San Antonio to Fort Yuma, required construction of forts and connecting roads, surveys of rivers and harbors as avenues of supply, and mapping of Indian trails. A significant part of the army was stationed between these two points and topographical engineers were assigned to military commands for which they provided necessary reconnoitering services.

By 1849, the country had begun to grasp the strategic value of Texas, the enormous potential of its vast, untapped resources, and the obvious commercial and settlement opportunities. Defense against the Indians, a prerequisite to any form of development, rose on the roster of federal priorities. Meanwhile, individuals and factions from widely divergent vantage points were clamoring for transportation routes between the Mississippi and the Pacific.

Early in 1849, Texas Senator Sam Houston called for a transcontinental survey. Subsequently, the Senate Committee on Military Affairs, headed by Jefferson Davis, recommended an appropriation of \$50,000 for surveys in Nebraska, California, New Mexico, and Texas, with an eye toward roads that would bind the country together.

Abert detailed Brevet Lt. Col. Joseph E. Johnston to make river surveys and explore routes for wagon roads in Texas. Many expeditions of topographical engineers fanned out across Texas in 1849 and great strides were made in closing the gaps in geographical knowledge of the region. Numerous routes were explored and laid out, some of which became major avenues of transportation. Although the country was on the threshold of the railroad era, the engineer officers never lost sight of the value of navigation. They sought routes that would connect with navigable waterways and repeatedly urged steps aimed toward facilitating river travel, which was less expensive than travel by freight wagon or pack mule.

In these reconnaissances conducted during 1849 and the several succeeding years, topographical engineers pushed back the western frontier and opened up the Southwest for settlement by clearing away the Indian

barrier and laying out lines of communications. Their major contribution, badly needed maps of the area, was put to immediate practical use by soldier, settler, and gold seeker. Expedience and sectional rivalry, however, took precedence over any carefully conceived master plan for continental expansion; Colonel Abert's vision of a federal communication network became "splintered into the fragmented surveys in West Texas and those through the Navaho country and among the gold fields of California."⁵

In several respects, the year 1853 marked a major turning point for the Topographical Corps. The survey of the Mexican-U.S. Boundary was winding up; settlement, less dependent upon the services of the engineers, was proceeding in orderly fashion; and the railroad issue had become the order of the day. Naturally, each section of the country wanted the railroad to run through its territory.

Rivalries among the various sections culminated in the Pacific Railroad Survey Bill passed by Congress on March 2, 1853. Under a skimpy appropriation of \$150,000, the bill charged Secretary of War Jefferson Davis to submit, by the first Monday of February, 1854, a full report on all practicable railroad routes to the Pacific based upon field surveys performed by parties under the supervision of topographical engineers.⁶

Capt. (later Maj. Gen.) George B. McClellan's expedition through the Northwest suggested that this route would entail great expense and tended to disqualify it as a prime contender. Lt. John W. Gunnison, who was massacred along with others in his party, demonstrated the infeasibility of Missouri Senator Thomas Hart Benton's "great central path" along the thirty-eighth parallel, again because of the expense involved in tunneling, bridging, and spanning gullies. Lt. Amiel W. Whipple, exploring the thirty-fifth parallel, retraced the junior Abert's route along the Canadian River and proceeded via Albuquerque to California. He was enthusiastic about this route and modified the earlier belief that the entire Southwest comprised a hostile, infertile environment.

When the topographical engineers began comparing relative merits of the alternate routes, they confronted a deficiency of adequate data on the thirty-second parallel route. As a result, two more expeditions were launched in the fall and winter of 1853-54. Lt. John C. Parke was sent to resurvey the Gila River route as far east as the Rio Grande; Capt. John Pope was assigned the eastern portion of the route between the Rio Grande and Preston on the Red River. Both expeditions encountered few obstacles, but noted the lack of water and advised drilling for artesian wells. Pope undoubtedly lived to regret this recommendation, spending the next 3½ years engaged in a futile search for water on the Llano Estacado.

The Pacific Railroad Survey by no means settled the railroad issue. Instead of designating one superior route for a transcontinental railroad, the surveys suggested that several practicable routes existed and, in essence, killed the possibility of any federally sponsored transcontinental railroad during the period prior to the Civil War. Failing to accomplish their primary purpose, they nevertheless produced an impressive compendium of knowledge. The massive reports of the railroad surveys were published between 1855 and 1860. Lt. Gouverneur K. Warren's map of the land west of the Mississippi represented a landmark in American cartography and provided the most comprehensive view of the West to that time.

The valuable information gained from the surveys and geographical explorations conducted by the topographical engineers contributed greatly to expansion of the western United States; it was a boon to development of transportation, settlement of communities, utilization of resources, and economic growth. The vigorous quest of the engineers for knowledge was manifested in their vast collection of meteorological data on the country through which railroads might pass, geological studies on the nature of the soil, awareness of natural resources such as coal and water sources, and in their attention to zoological and botanical factors as they might pertain to development of the territory. Their application of engineering expertise to promote economic development was as vital to westward expansion as it had been years earlier to the growth of internal improvements.⁷

Although the prestige of the Topographical Corps began to decline during the 1850s, the demand for services of its engineers climbed steadily. Roads were urgently needed and, while Congress debated whether jurisdiction for these public works should continue under the War Department or be transferred to the Department of the Interior, topographical engineers were out in the territories working on them. Major river and harbor appropriations in 1852 caused the return of many works to the Corps of Engineers; for the next decade, the two engineer corps shared these works.⁸

Two of the last expeditions in Texas led by the topographical engineers were conducted in the summers of 1859 and 1860 by Lt. William H. Echols. Similar to the surveys undertaken by Col. Joseph Johnston and his officers in 1849-50, these expeditions attempted to locate appropriate supply routes for isolated army outposts. One striking difference distinguished these expeditions from those ten years earlier.

As early as 1853, Secretary of War Davis had expressed his dissatisfaction with the use of horses, mules, and oxen to draw wagons carrying supplies for military outposts, particularly those in arid regions where

water and vegetation were at a premium. Allowing that a railroad would alleviate the problem somewhat, he indicated there were still remote regions in the interior that would not benefit from the railroad and he suggested a novel plan for trial:

For . . . military purposes, for expresses, and for reconnoissances [sic], . . . the dromedary would supply a want now seriously felt in our service; and for transportation with troops rapidly moving across the country, the camel . . . would remove an obstacle which now serves greatly to diminish the value and efficiency of our troops on the western frontier.

For these considerations it is respectfully submitted that the necessary provision be made for the introduction of a sufficient number of both varieties of this animal, to test its value and adaptation to our country and our service.⁹

Lieutenant Echols drew this assignment and his two expeditions tested the usefulness of Arabian camels as beasts of burden in supplying the frontier garrisons. The 1859 expedition set out from Camp Hudson on the Devil's River near the edge of the Edwards Plateau country.

Strung out over the dazzling landscape were twenty-four camels, burdened with packs and water casks weighing up to 500 pounds each. They were tended by special camel drivers, who were unfortunately so inept at loading the beasts that the packs and water casks kept crashing to the ground.¹⁰

In their journey across the Pecos to Fort Davis and on to Camp Stockton and in a reconnaissance of the Big Bend country, the camels bore their burdens successfully; in contrast, the horses and mules with their incessant needs for water were a constant hindrance.

The 1860 expedition was a different story. Crossing the wastelands west of the Pecos, the party was subjected to an inhospitable stretch of 120 miles and four days without water.

The mules cried piteously and gnawed the canteens, the soldiers slept on their individual water supply, vigilant lest a comrade steal it, and finally the camels began to bellow in hideous fashion, which suggested that even they had reached the limit of endurance.¹¹

Fortunately, Echols located water in time to preserve the integrity of his command. He moved on, succeeded in selecting a fort site on the Rio Grande, and improved existing Indian trails into suitable military roads as the party proceeded. But the camel experiment ended on a dismal note and the gangling beasts were sold at public auction by the Quartermaster Corps.¹²

By 1860, the prestige of the Topographical Corps had reached a low ebb, private capital had made its entrance into the road building scene, and the era of the topographical engineers was on its way out. The outbreak of Civil War hostilities in 1861 hastened organizational disintegration of the Topographical Corps. Abert retired in that year; he was replaced by Col. Stephen H. Long in the couple of years that remained. Returned to the subordinate status it had held in 1831, the Topographical Corps was "legislated into oblivion" on March 3, 1863, through a merger with the Corps of Engineers under General Totten.¹³

The Gulf Coast Engineers

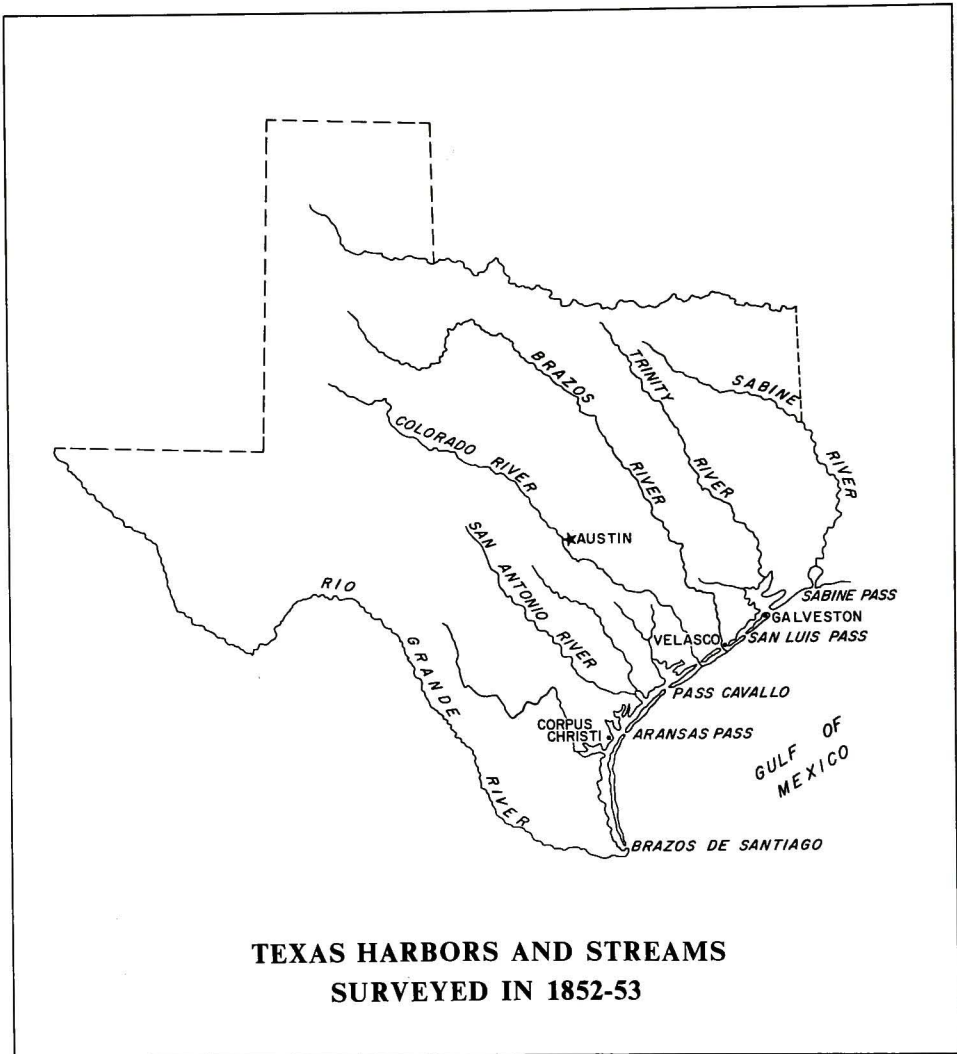
During the years when the topographical engineers were exploring the Texas interior, the Corps of Engineers was discharging both military and civil duties on the Gulf Coast. From Pensacola, the superintending engineer for the Gulf of Mexico Frontier directed engineer activities on the coast between 1828 and 1856. On and off, engineer officers were assigned temporary duty in New Orleans. In September, 1840, Lt. (later Capt.) Henry L. Smith was sent to serve with Capt. John C. Barnard; they were joined within a year by Lt. Pierre G. T. Beauregard. Following the disruption of the War with Mexico, Beauregard emerged in 1852 with assorted responsibilities formerly under Barnard's command and orders from Washington to carry out an ambitious program of civil works. During the short-lived (1852-53) revival of federally funded internal improvements, army engineers conducted examinations for various river and harbor works in Mississippi, Louisiana, and soon thereafter, in Texas.¹⁴

The Rivers and Harbors Act of August 30, 1852 sparked extensive, but quickly extinguished, federal interest in the Texas Gulf Coast that was not rekindled until late in the 1860s. Congress appropriated \$1,500 for survey of the San Antonio River and \$5,000 for surveys of harbors at Sabine, Galveston, Pass Cavallo, Velasco, Brazos de Santiago, and Corpus Christi, and for the Rivers Sabine, Brazos, and Trinity.¹⁵

Lt. George B. McClellan, chief engineer of the Department of Texas, surveyed the bars from Pass Cavallo to the mouth of the Rio Grande early in 1853. Following this assignment, he led the Pacific Railroad Survey



Maj. Gen. George B. McClellan (Library of Congress)



expedition of the northwestern route through the Cascade Mountains. McClellan would achieve still greater distinction in the years ahead as a Union soldier in the Civil War and, in 1864, as an unsuccessful contender against Abraham Lincoln for the national presidency.¹⁶

Lt. William H. C. Whiting examined the bar at Velasco at the mouth of the Brazos and conducted reconnaissances of the Colorado and Trinity rivers. Lt. Walter H. Stevens examined the San Antonio River and the bar at the entrance to Galveston Harbor. Lt. Henry L. Smith surveyed the Sabine River.¹⁷

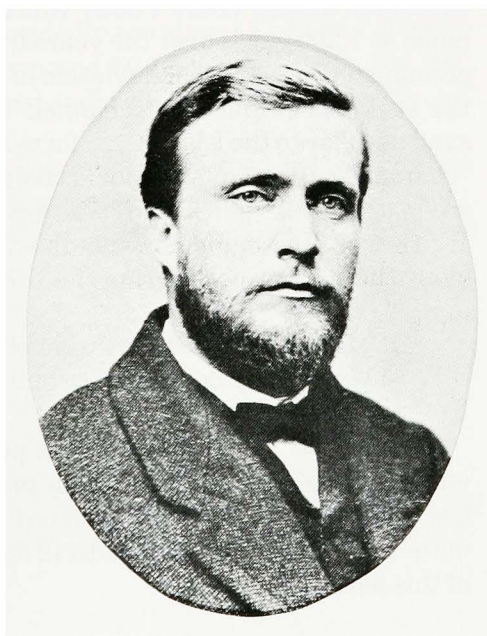
Lieutenant Smith, who had been assigned river and harbor responsibilities in Mississippi, Louisiana, and Texas, succumbed to yellow fever

in September, 1853. Responsibility for Texas was turned over to Beauregard, and later to his assistant, Lt. Walter H. Stevens. An Engineer Department order on April 9, 1857 created a Board of Engineers for the Gulf Coast, on which Beauregard enjoyed senior rank and Stevens represented New Orleans and Galveston. In general, this organizational structure was maintained until the eve of the Civil War, when engineer officers joined fighting units for either the Union or the Confederacy.¹⁸

The war gave rise to a Department of the Gulf which existed until 1865. From it, two distinct commands emerged. The military division, serving the needs of the army, was renamed the Department of the Gulf in August, 1866 and later became part of the Fifth Military District composed of Texas and Louisiana. The other command, concerned with immobile fortifications, evolved into the postwar New Orleans Engineer Office.¹⁹

In June, 1865, Maj. Miles D. McAlester was appointed chief engineer of the Department of the Gulf, shortly before its demise. By March, 1866, he was described as the officer "in charge of Engineer operations on the Gulf of Mexico." Within a year, the U.S. Engineer Office had returned to peacetime operations. Passage of a decade would find the New Orleans Engineer Office superintending an impressive array of river and harbor activities in Louisiana and Texas. Operations in Texas continued to be directed by the engineer in charge at New Orleans until the Galveston Engineer Office was established in 1880.²⁰

Maj. Miles D. McAlester
(Library of Congress)



Engineer activity on the Texas Gulf Coast resumed with passage of the Rivers and Harbors Act of March 2, 1867. In its very last paragraph, this act directed the secretary of war

. . . to cause plans and estimates to be made of the most practicable and effective mode of improving the harbor at Galveston, Texas, and of erecting suitable breakwater at that point.²¹

This unobtrusive paragraph marked the beginning of continuous federal commitment in the coastal region of Texas.

"The Best Harbor on the Texas Coast"

Conducting surveys in the early 1850s and, later, in the years after the Civil War, the army engineers encountered a striking resemblance among harbor entrances in Texas. At each pass, the southern headland projected further into the Gulf than did the northern headland (notably, Galveston, San Luis Pass at West Galveston Bay, Pass Cavallo at Matagorda Bay, and Aransas Pass). Littoral currents in these locations, acting in concert with the prevailing easterly winds, caused the lands south of each pass to gradually wear away.²²

Indeed, such erosion was dramatically evident at the eastern tip of Galveston Island (Fort Point) which had actually shifted westward as much as 1,200 yards over the years from 1841 to 1870. This relocation was accompanied by gradual deviation of the main channel and formation of a bar at the inner end of the channel. The bar was formed of "fine rounded sand peculiar to the islands . . . forming the Gulf coast" and possessing the "characteristics of quicksand." Easily moved by current and hazardous to navigation, this "quicksand" was described by Capt. (later Maj.) Charles W. Howell, the engineer who directed river and harbor improvements along the Texas Coast during the 1870s:

It affords the least desirable of all foundations upon which an engineer may be obliged to build.²³

In 1853, Lt. W. H. Stevens had presented to General Totten the first engineer proposal to deepen the inner bar, by prolonging the head of Galveston Island. Stevens observed that the 30-foot depth over the bar, noted in 1841, had diminished to 12 feet. His recommendation for removal of this bar was:

. . . to throw a breakwater from east end . . . [to] intercept the breakers from the southeast, and force the current which cuts across the end of the island into the channel . . .

He advised that the estimate for this work should be based on at least six months of "careful observations . . . by a person of intelligence."²⁴

This proposal seemingly came to naught. Not until 1867 did the engineers again turn their attention to improving Galveston Harbor. In the interim, shoaling had been abetted by chain and pile obstructions placed across Galveston Channel as a blockade during the Civil War. Early in 1867, the U.S. Coast Survey found a scant 9½ feet of water over the inner bar at mean low tide. Noting this decreased depth, Chief of Engineers Brig. Gen. (later Maj. Gen.) Andrew A. Humphreys instructed Major McAlester to study the situation.²⁵

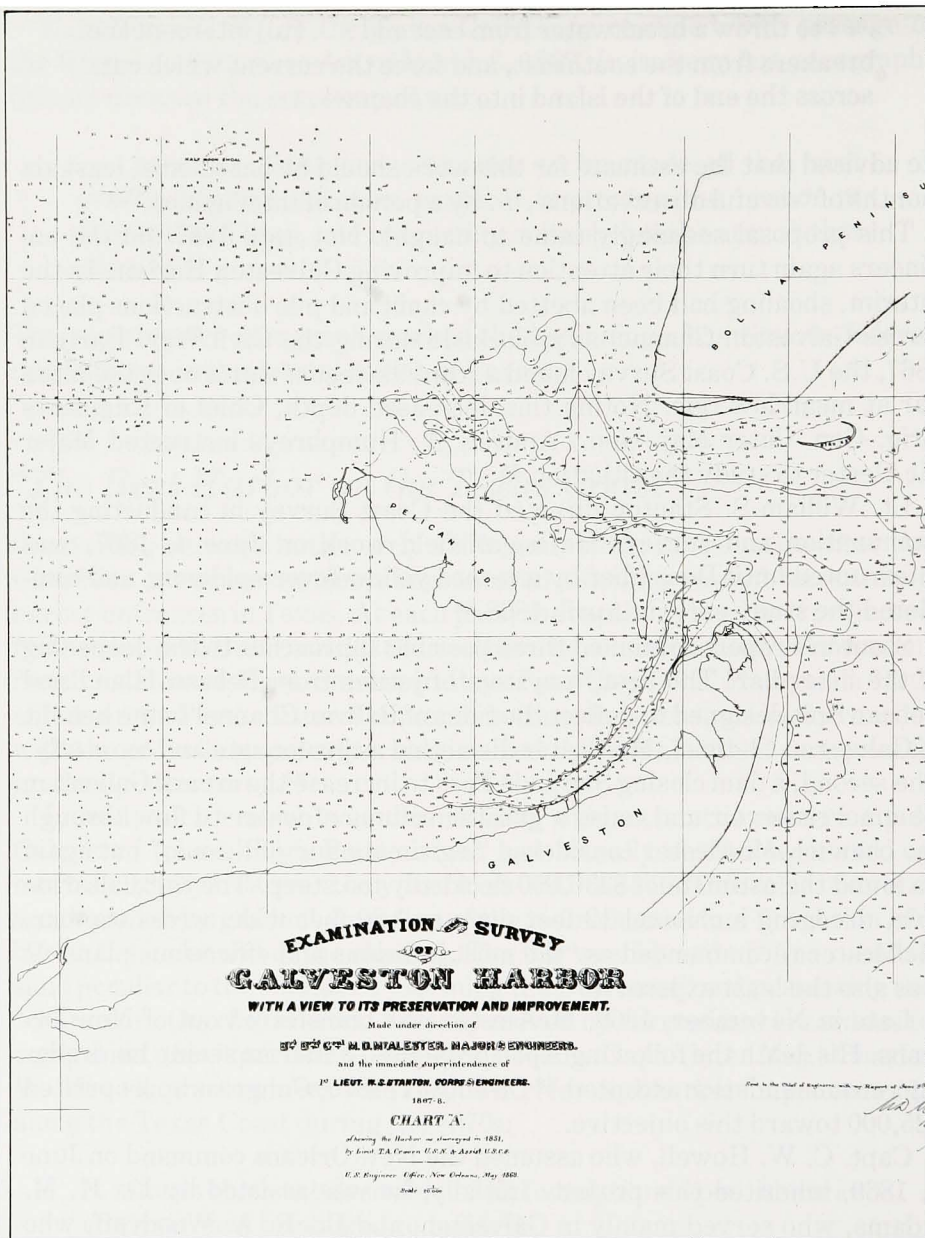
Lt. William S. Stanton directed the Coast Survey in conducting the examination and survey. He began field work on June 4, 1867, was interrupted until December by a record yellow fever epidemic, and completed the study early in April, 1868.²⁶

Stanton's report contained three possible approaches to the deepening of the inner bar. The first, a system of jetties from Pelican Island and Pelican Spit designed to deflect the tides of Bolivar Channel to the benefit of Galveston Channel, McAlester dismissed as inadequate and too costly. The second, a dam closing San Luis Pass to increase the area of Galveston Channel reservoir and cause a greater volume of water to flow through the channel, McAlester considered "legitimate and judicious," but again he found the estimate of \$330,000 decidedly too steep. The third alternative, dredging a channel 12 feet deep and 80 feet wide across the bar, McAlester recommended as "the most judicious and efficacious plan." It was also the least expensive.²⁷

Late in November, 1868, McAlester was transferred out of New Orleans. His death the following April prevented him from seeing his dredging recommendation accepted.²⁸ On July 11, 1870, Congress appropriated \$25,000 toward this objective.

Capt. C. W. Howell, who assumed the New Orleans command on June 7, 1869, inherited this project. Initially, he was assisted by Lt. H. M. Adams, who served mainly in Galveston, and Lt. E. A. Woodruff, who surveyed the coastal and inland waterways.

Howell was directed to carry out the dredging work on a contract basis. This proved infeasible. It was next proposed to hire floating plant, to purchase fuel, provisions, and other needed supplies, and to employ the labor required to prosecute the work direct from the New Orleans Office. Again thwarted, Howell indicated,



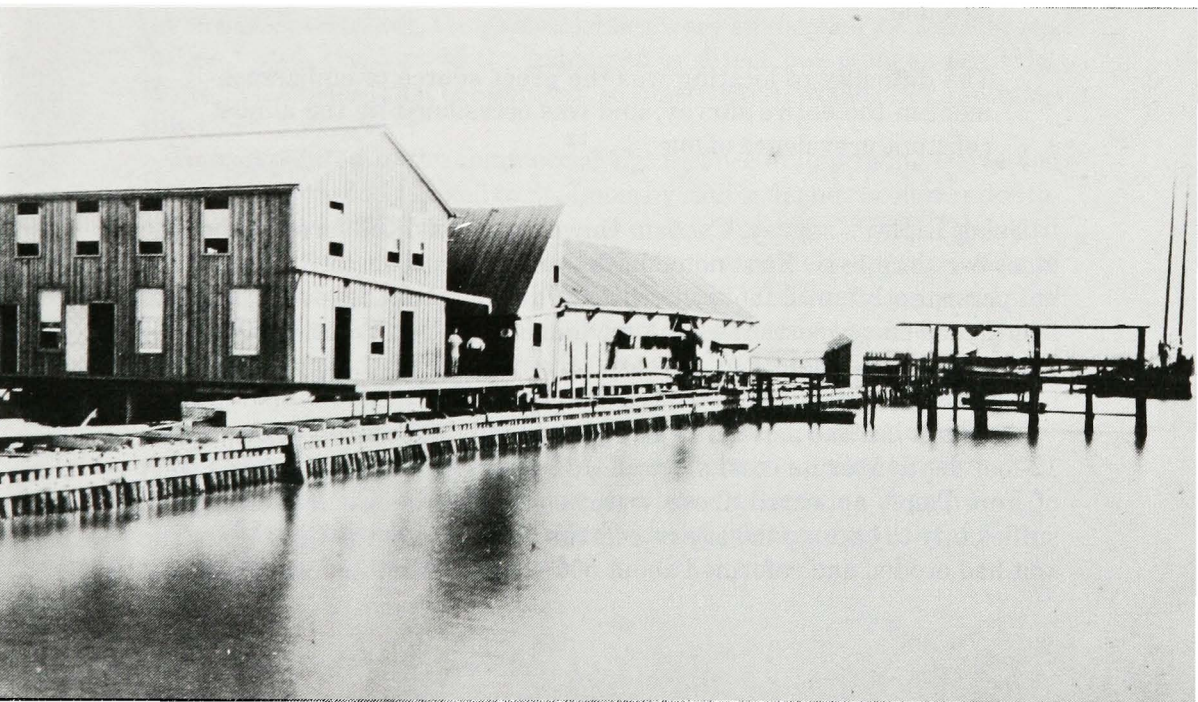
*Map produced by Examination and Survey of Galveston Harbor, 1867-68
 (National Archives)*

After much time spent in search of an available dredge, I was forced to abandon this project, all dredges on this coast being fully employed in more remunerative work.²⁹

In April, 1871, he received authority to purchase a dredge-boat, two dump-scows, and a tugboat.

By the time Howell acquired these vessels, he had no occasion to use them because scouring had increased the capacity of the channel across the inner bar to a depth as great as that across the outer bar. The boats were put to other use during the year and the appropriation for harbor improvement was applied to extending and strengthening the pile breakwater at Fort Point. Begun in 1869, this frail structure had been the first attempt to implement an improvement along the lines originally proposed by Lieutenant Stevens. Financed by the city of Galveston and spearheaded by Charles Fowler, a former seaman who had become manager of the Morgan interests at Galveston, the breakwater had been completed in 1870 as far as city funds permitted.³⁰ Although unequal to the long-term challenge of withstanding the force of the currents and waves that battered its pilings, this breakwater almost immediately checked erosion and stabilized Fort Point's position. By 1873, the rehabilitated breakwater had been extended beyond a mile in length and had succeeded in deepening the water along the front of it.

Pile breakwater and Engineer Department quarters and workshops at Fort Point, 1875



Howell viewed Galveston as the most central, "if not the best harbor on the Texas coast," considering it the harbor "most susceptible of permanent improvement, to meet the full requirements of commerce." Acknowledging the possible disputability of the claim that the harbor entrance had once been 30 feet deep, he declared with certainty that shoaling of the inner bar had continued to occur within recent years and he recommended:

. . . that only the harbor of Galveston be selected for improvement, and such dribblets of appropriation as might otherwise be wasted on other Texas harbors be consolidated, to inaugurate a permanent and valuable work at Galveston.³¹

Civil Assistant Engineer Henry Clay Ripley undertook surveys preliminary to a plan for permanent works of improvement. Ripley had to overcome many difficulties in discharging this assignment. Undaunted, he made the best of an unsatisfactory transit for the triangulations and uncooperative weather:

. . . the tug "Hall" . . . was used for outside soundings, and a small four-oared boat for inside and shallow soundings. I was able to utilize much of the windy weather by sounding outside when the wind blew off shore and inside when it blew from the Gulf. The only drawback to this admirable arrangement was the exceeding difficulty in preventing the "Hall" from getting aground.

The difficulty of locating was the great source of embarrassment in the entire survey, and was occasioned by the almost constant prevalence of fog³²

Using Ripley's survey, Captain Howell reviewed the formation of the inner bar since 1841. First noted in 1843, the bar had shoaled "irregularly but persistently" until 1867, when it afforded only 9 feet in depth, and had lengthened in proportion to the movement of Fort Point. Subsequent works of improvement had increased the depth over the inner bar to 12 feet by 1872.³³

The outer bar had moved slightly gulfward and essentially maintained a 12-foot depth over its crest since 1841. Pelican Spit, a shoal located west of Fort Point, appeared above water some time before 1851 and grew sufficiently to become the site of a fortification during the Civil War. The spit had eroded and reformed about 500 yards west of its initial position,

become considerably wider at its southern end, and was moving toward Pelican Island faster than Fort Point, thereby increasing the distance between them.³⁴

The "Cement Pot Jetty" Experiment

Howell clung tenaciously to his original notion of a "permanent" improvement for Galveston Harbor. His proposal, submitted to the chief of engineers in December, 1873, was calculated to remove the inner bar between Fort Point and Pelican Spit and to deepen the channel over the outer bar to a depth of 18 feet. This was to be accomplished by extending the city breakwater northeast to the verge of the Bolivar Channel, where it would cause sufficient scouring to remove the inner bar. The structure would then turn seaward and advance toward the outer bar, accompanied by a parallel jetty constructed from Bolivar Point. Because of its novelty and the large expenditure involved, his proposal was referred to a board of engineer officers.³⁵

The novelty in Howell's scheme lay in the proposed method of construction. At that time, there were no known stone quarries in Texas and the cost of transporting this material from the North would have been prohibitive. Seeking a more economical device, Howell advocated the use of gabions (cylindrical, cage-like structures of woven wicker), to be covered inside and out with hydraulic cement and filled with sand by a dredge-boat alongside as they were placed into position. The plan called for the gabions to be 6 feet in diameter and 6 feet high, with two rows in each jetty, fastened together at the top by copper wire. To act as training walls for the lower ebb current, the gabion jetties were envisioned as "submerged jetties," with the tops of the gabions 5 or 6 feet below mean low tide. Howell anticipated that the gabions, so constructed, would offer a suitable substitute for stone.³⁶

Howell pointed to the commercial significance of improving Galveston Harbor, now directly linked to St. Louis by railroad, and recommended an appropriation of \$500,000 for the year ending June 30, 1875.³⁷ The board of engineers recommended a somewhat more modest appropriation of \$60,000. Although viewing with favor the plan of Howell's proposal, the board was less confident of the method of construction entailed:

If Captain Howell's plan should succeed — and it is impossible to say that it would not — it will supply the desideratum of a cheap method of construction which might be applied to many other localities where, otherwise, no attempts at improvements would be made in consequence of the necessarily heavy outlay they would involve.³⁸

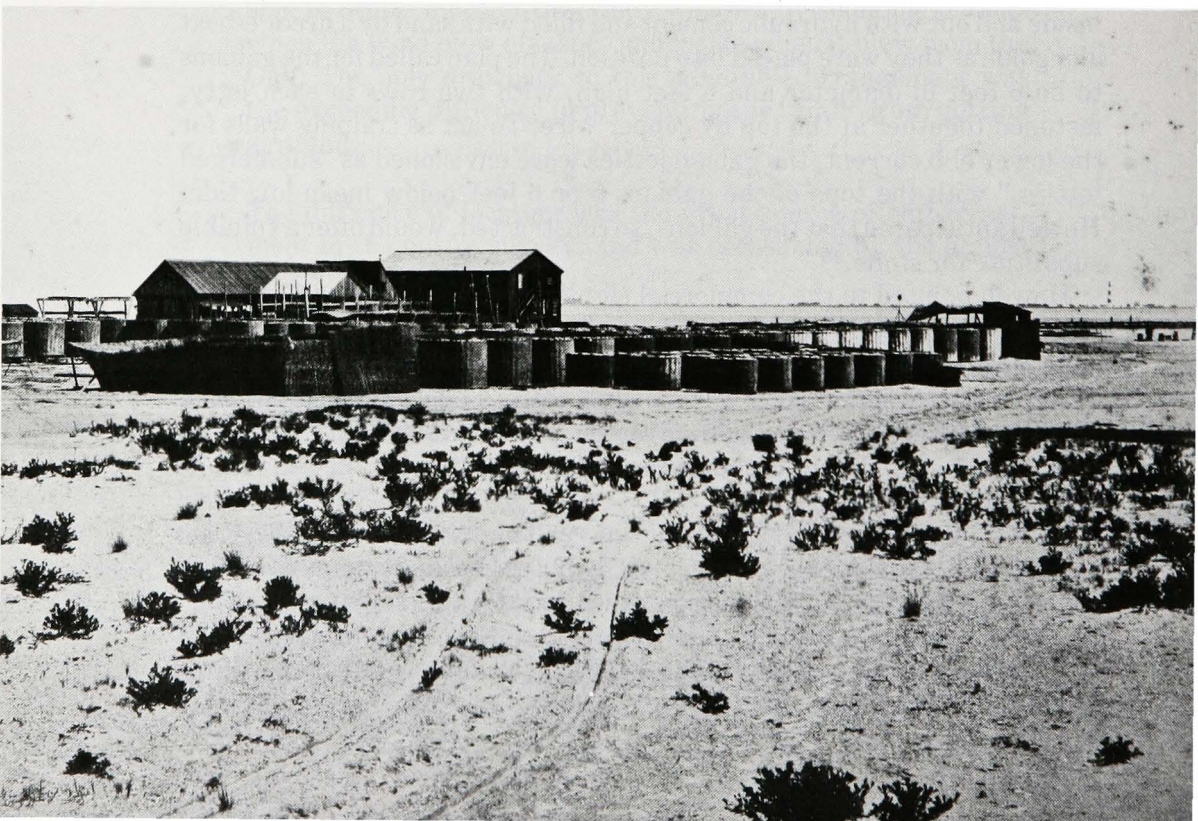
This rationale led to a trial that involved constructing an extension of the city pile breakwater on the Fort Point side and also laying a small portion of jetty from Bolivar Point near the outer bar extremity to test its efficacy in an exposed position.

Lt. (later Col.) James Baird Quinn arrived in Galveston late in August, 1874, to assume personal supervision of the experimental work. This distinctive officer would later be described by the man who had been his roommate at West Point as:

Bearded like a pard
And as mild a mannered a man
As ever scuttled a ship or
Cut a throat.³⁹

Quinn was assisted by Overseer R. M. Pease and H. C. Ripley, who served as principal assistant on surveys. Acquisition and storage of materials, construction of buildings, manufacture and placement of gabions, and purchase and construction of boats, machinery, and other necessities were Quinn's immediate concerns.⁴⁰

Grounds and buildings used for gabion construction



Innumerable delays prevented initial construction of the experimental gabions until November 1. Pease, compensated at the rate of \$125 a month, supervised his force of forty-five men. The work was divided into the fabrication and the sinking of the gabions, each phase under immediate direction of a foreman. Carpenters prepared the tops and bottoms of the gabions and rolled them outside the shed to the weaving ground, where stakes were set up and matting completed. The brush-trimmers and makers of mats and fascines (long bundles of wooden sticks bound together) improvised shelter by planting stakes in the sand, connecting the tops by strips of lumber, and covering this structure with the finished mats. Concern for working conditions of these men prompted this early statement of personnel policy:

Prolonged exposure to the sun is avoided as much as possible. Strict sobriety is enforced, and remarkably good health prevails among the employés.⁴¹

The gabions were next taken to the cementing ground, completed, and placed on a launching platform to dry. Once the cement had hardened, the sinking party placed them on a schooner or flat, fastening them together in a single row on each side of the vessel. Gabions were floated against guide piles, filled with water, and sunk. A second row was sunk beside them and the gabions were filled with sand. Finally, mats were laid to prevent undermining.

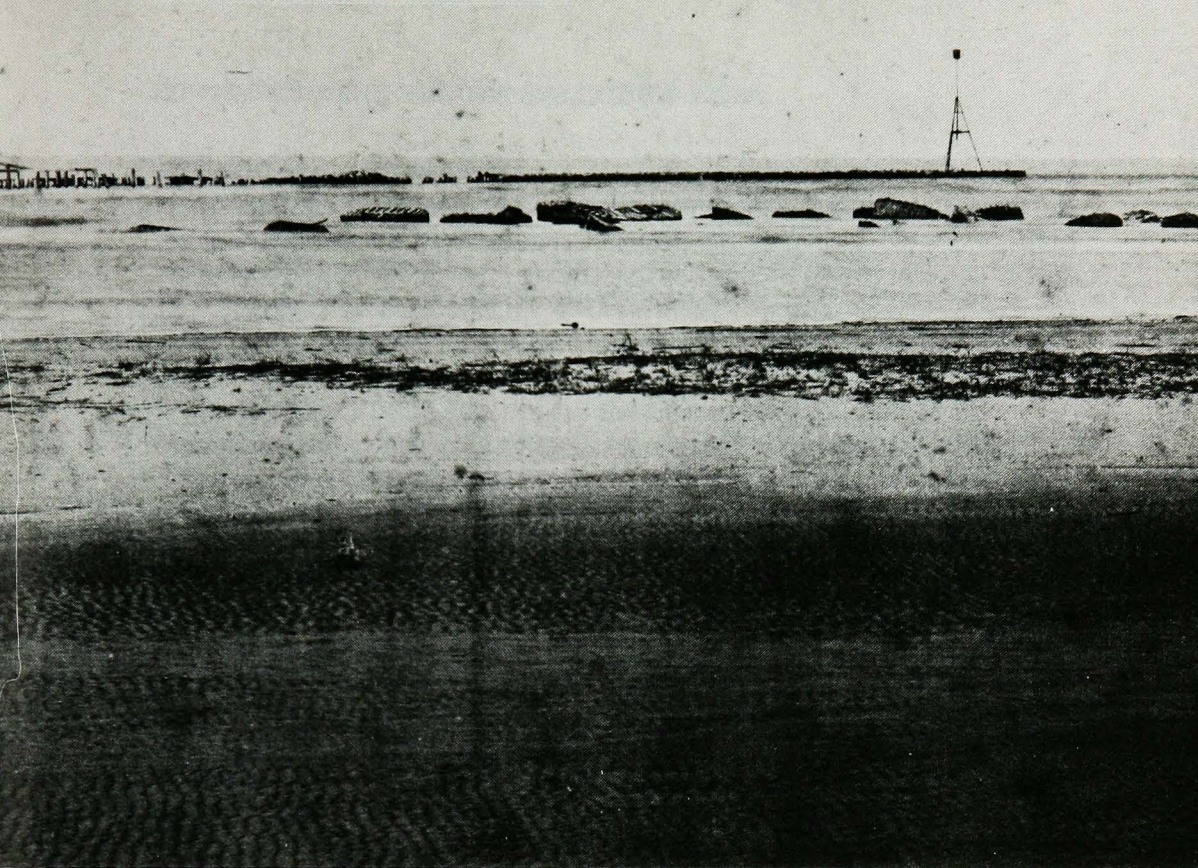
The gabion jetty construction provided a classic example of the maxim that if something can go wrong, it will. Handicapped by unavailable materials, undesirable weather, insufficient appropriations, work suspensions, and a host of other unanticipated obstacles, Howell and his men somehow managed to inch the work forward.

The elements proved a formidable adversary. Rough weather repeatedly interrupted the work and vicious storms demolished completed structures. One particularly savage storm struck the island during September 14-17, 1875. The tide rose rapidly, eventually inundating many commercial buildings on the Strand. All the buildings at Fort Point were swept away. Gradually shifting around to the northwest, the wind drove the vast accumulation of water in the bay back out to sea, significantly altering the east end of the island.⁴²

Employees at Fort Point, cut off by the storm, found themselves in considerable peril. Rescue operations were heroic. Pease, who had himself just been rescued "while drifting in the harbor," together with Assistant Engineer R. B. Talfor, other engineers, boat captains, and a volunteer lifeboat crew composed of pilots and other Galveston citizens,



Fabrication of gabions. Workmen at right set stakes in wooden bottoms as man to their left performs "basket-weaving" function. Gabion in left foreground is covered with hydraulic cement. Old fort appears in background.



Condition of construction grounds after storm of September 15, 1875

succeeded in bringing in all but two of the men left at Fort Point. The half-drowned men were brought in to the wharf, reclothed, and fed. Howell noted,

These men saved, lost nearly all their personal effects, and are deserving remuneration, the more so as they waited until cut off, working to save Government property.

Of the two men lost, "one was killed by the falling timber of the men's quarters, and the other drowned by being overweighted with clothing."⁴³ Losses in property amounted to \$50,000.⁴⁴

The board of engineers reconvened in December, 1875. Turning their attention toward the outer bar, these officers concluded that the parallel jetties as originally proposed would produce an important increase in the depth over this bar. They recommended that the first portion be constructed from Fort Point toward the main channel, and that gabions not be adopted definitively until further tested by extension of the inshore end of the Fort Point jetty and construction of a more exposed, north jetty extending from Bolivar Point.⁴⁵

In May, 1876, Lt. Charles E. L. B. Davis arrived in Galveston to relieve Quinn.⁴⁶ His first year superintending the Galveston work was punctuated by work stoppages due to lack of funds. These suspensions squandered the most propitious season for construction and resulted in dispersal of skilled laborers and deterioration of plant. Howell's disappointment and inevitable frustration were barely veiled when he stated:

I beg leave to again respectfully represent in official report that I am convinced, from such experience as I have had, that if any work of river or harbor improvement is worth undertaking it should be provided for by adequate and timely appropriation.⁴⁷

Consistent with Howell's luck, exhausted appropriations forced yet another interruption of the work from November 30, 1877 until June 15, 1878.⁴⁸

The Fort Point gabionade was completed in June, 1877. To its bitter end, this jetty was complicated by problems. Unseasonably rough weather made its usual contribution and the final work on the last few gabions was characteristic:

The last 2 gabions placed at Fort Point, in about 23 feet of water, had to be filled by shoveling sand from the deck of a barge, as the bottom was a dark blue clay, which could not be raised by the pump. The sand was shoveled into a hopper leading into the gabion filling-hole, 5 men shoveling and 1 playing an inch and a half stream of water to keep the chute from choking. It took about 3 hours to fill these 2 gabions.⁴⁹

Beneficial changes continued to accrue on the inner bar. A survey in June, 1878, revealed a widened, 20-foot least depth where there had formerly existed a narrow, intricate channel of only 12-foot depth. Encouraged by these changes, Howell commented,

The results [over the inner bar] . . . may even lead one less sanguine than myself to confidently look for results on the outer bar equally as gratifying . . .⁵⁰

Work on the Bolivar jetty to improve the outer bar began in mid-April, 1877. Beginning at the shore, a double row of pine piling, capped and braced, with sheetpiling on the seaward side was continued out 513 feet where the gabionade proper began in 6 feet of water. Because of the

muddy bottom, the gabions were filled by barrows from the shore, run out on a plank laid over the piling of the breakwater and the guide piles of the gabions. On September 17, 1877, the entire pile structure was swept away by a severe storm. Work on the Bolivar gabionade was resumed in June, 1878. By 1879, this structure appeared to have produced no important results and it was presumed that the gabionade had not yet been extended far enough into the sea to effect changes on the outer bar.⁵¹

Some 6½ years and \$477,000 later, the board of engineers reviewed the matter of Howell's proposed improvement. In its report of August 9, 1879, one succinct sentence summarized the success of the scheme: "There is no very cheap way of building jetties into the ocean."⁵² The board alluded to the "magnitude" of constructing 7 miles of piers into the open waters of the Gulf as "an undertaking of its kind unprecedented in this country."⁵³ The only comparable harbor conditions they could cite were those at the mouth of the Maas in Holland. The Dutch had utilized alternate layers of mattress and stone, protected on the slopes and top above water by large stone blocks. The board expressed confidence that this system would be as successful at Galveston as it had been in the Maas improvement. In conclusion, the board recommended that no more gabions be manufactured, that those on hand be strengthened and used for further experiment, and that trial be made using the Maas dike as a model.⁵⁴

Overall, these diverse failures and inconclusive efforts composed the prelude to the Galveston Engineer Office. The fragmented surveys inland, the camel fiasco, the sporadic interest in the Texas coastline, and Howell's frustrating struggle with the gabion jetty — all manifested various facets of the great push toward western expansion.⁵⁵ Contributing to this series of unsuccessful ventures was the tentative nature of the government's commitment to civil improvements.

Although the uniquely trained West Point engineers looked upon development of national waterways as their professional duty, neither Congress nor the president shared this viewpoint during most of the years from 1838 until after the Civil War. Consequently, the engineers were hamstrung by a desultory, if not nonexistent, program for internal improvements. On the Texas Gulf Coast, virtually no federal activity had followed the river and harbor surveys of 1852-53.⁵⁶

The period of Reconstruction ushered in a more positive approach to federal responsibility for public works. During the 1870s, the Corps of Engineers conducted numerous examinations and surveys and began improvements along the Texas Coast, from the Rio Grande to the Sabine River, and inland, as far north as the Red River. From these beginnings grew the need for a U.S. Army Engineer Office located at Galveston.

Notes to Chapter 1

¹ This account of the early organizational development of the Corps of Engineers is based on Forest G. Hill, *Roads, Rails & Waterways: The Army Engineers and Early Transportation* (Norman: University of Oklahoma Press, 1957), pp. 22, 10, 47-49, 213, 221-22.

² Unless otherwise indicated, this history of the topographical engineers is drawn from William H. Goetzmann, *Army Exploration in the American West, 1803-1863* (New Haven: Yale University Press, 1959).

³ *Ibid.*, p. 109.

⁴ The source of the name *Llano Estacado* remains questionable. Some theories that have been advanced include: "(1) Spanish legend says stakes were driven to mark the only trail across the desert. (2) Indians claim that their ancestors drove stakes to guide an unknown Great Chief who would come from the east to deliver them from their enemies. (3) Josiah Gregg, famed historian of western commerce, says the stakes marked the course between water holes. (4) Later travelers believed the stakes had been set and adorned with buffalo skulls to mark the route of the Butterfield Overland Mail." James A. Michener, *Centennial* (New York: Random House, 1974), pp. 497-98.

⁵ Goetzmann, *Army Exploration*, p. 261.

⁶ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 16-23.

⁷ Hill, *Roads, Rails & Waterways*, p. 220.

⁸ Goetzmann, *Army Exploration*, p. 346; Hill, *Roads, Rails & Waterways*, p. 222.

⁹ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 25.

¹⁰ Goetzmann, *Army Exploration*, pp. 363-64.

¹¹ *Ibid.*, p. 364.

¹² Odie B. Faulk, *Land of Many Frontiers: A History of the American Southwest* (New York: Oxford University Press, 1968), p. 183.

¹³ Goetzmann, *Army Exploration*, pp. 431-32.

¹⁴ Albert E. Cowdrey, *The Delta Engineers* (New Orleans: U.S. Army Engineers, 1971), pp. 10-11.

¹⁵ Ch. 104, 10 Stat. 56.

¹⁶ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 560-66; George Washington Cullum, *Biographical Register of the Officers and Graduates of the U.S. Military Academy at West Point*, 3d ed., rev. and ext. (Boston and New York: Houghton, Mifflin and Company, 1891), 2: 252-54.

¹⁷ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 552-60, 566-78.

¹⁸ Cowdrey, *Delta Engineers*, pp. 11-12.

¹⁹ *Ibid.*, pp. 14, 70.

²⁰ *Ibid.*, p. 14.

²¹ *Laws of the United States Relating to the Improvement of Rivers and Harbors from August 11, 1790 to June 29, 1938*, 3 vols. (Washington, D.C.: Government Printing Office, 1940), 1: 165.

²² *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1871* (Washington, D.C.: Government Printing Office, 1871), p. 519 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).

²³ H.R. Ex. Doc. 136, 43d Cong., 1st sess. (1874), p. 11.

²⁴ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 560.

²⁵ *ARCE*, 1868, p. 498.

²⁶ *Ibid.*, pp. 498-99.

²⁷ *Ibid.*, pp. 497-517.

²⁸ Office of the Chief of Engineers, General Order 5, 24 April 1869.

- ²⁹. *ARCE*, 1871, p. 517.
- ³⁰. *Ibid.*, p. 521.
- ³¹. *Ibid.*
- ³². H.R. Ex. Doc. 136, 43d Cong., 1st sess. (1874), p. 8.
- ³³. *Ibid.*, p. 12.
- ³⁴. *Ibid.*, pp. 11-12.
- ³⁵. *Ibid.*, pp. 14, 1.
- ³⁶. *ARCE*, 1880, pp. 1221-22; H.R. Ex. Doc. 136, 43d Cong., 1st sess. (1874), pp. 14, 17.
- ³⁷. H.R. Ex. Doc. 136, 43d Cong., 1st sess. (1874), p. 17.
- ³⁸. *Ibid.*, p. 19.
- ³⁹. U.S. Military Academy Association of Graduates, *Annual Reunion*, June 1915, p. 161.
- ⁴⁰. Details of the work conducted under Quinn during 1874-75 are contained in *ARCE*, 1875, pp. 846-68.
- ⁴¹. *Ibid.*, p. 860.
- ⁴². *ARCE*, 1876, p. 566.
- ⁴³. *Ibid.*, pp. 580-81.
- ⁴⁴. *Ibid.*, p. 567.
- ⁴⁵. *Ibid.*, pp. 581-84.
- ⁴⁶. *Ibid.*, p. 575.
- ⁴⁷. *ARCE*, 1877, p. 447.
- ⁴⁸. *ARCE*, 1879, p. 910.
- ⁴⁹. *ARCE*, 1877, p. 450.
- ⁵⁰. *ARCE*, 1878, p. 606.
- ⁵¹. *Ibid.*, p. 603; *ARCE*, 1879, pp. 911-12.
- ⁵². *ARCE*, 1880, p. 1271.
- ⁵³. *Ibid.*, p. 1269.
- ⁵⁴. *Ibid.*, pp. 1270-71.
- ⁵⁵. Despite his failures, Howell initiated many of the significant accomplishments of the Galveston District. This interesting young officer, who had graduated seventh in his West Point class of 1863, struggled against enormous odds and exhibited remarkable vision in approaching various projects on the Gulf Coast. He died prematurely, at the age of forty, on 5 April 1882. George Washington Cullum, *Biographical Register of the Officers and Graduates of the U.S. Military Academy at West Point*, 3d ed., rev. and ext. (Boston and New York: Houghton, Mifflin and Company, 1891), 3: 1-2.
- ⁵⁶. Hill, *Roads, Rails & Waterways*, pp. 194-98.



The Stubborn Sandbar

Galveston Island – Threshold to the Southwest

One great disadvantage of the improvement of the Texas coast has been this, the headquarters of the engineer service in the southern section has been at New Orleans, and too much of the money appropriated has been spent on pet projects around that section; but now the prospects are that one or two engineers of high rank will be stationed with headquarters at Galveston to look after the coast of Texas, and in this event that coast will get its just proportion of the appropriations in the river and harbor bill.¹

Such were the sentiments expressed by the *Galveston Daily News* at the outset of 1880. Texans in general and Galvestonians in particular clamored impatiently for more active federal participation in coastal improvements. Viewed against the background of developments which had occurred since Texas acquired statehood, their frustrations were understandable.

Soon after the United States annexed Texas late in 1845, the economic and political life of the young state presented a microcosm of the national preoccupation with transportation. In Texas, roads were poor; streams were not bridged and, in many cases, not navigable. Onerous freight expenses cut deeply into the profits of inland farmers and businessmen. Their cries grew louder and more insistent for some economical way to move the abundant produce of the interior — cotton, grain, cattle, lumber, wool, horses, cottonseed, hides, sugar, and molasses — to their respective markets.

Even before the railroad mania swept the country, the Republic of Texas had recognized the potential of the railroads, granting the first charter for a line as early as 1836. A number of additional charters were

Opposite page: Galveston Harbor in 1904 as depicted by artist Julius Stockfleth. Jetties and jetty railroad appear in left foreground, running from end of original county seawall near Eighth Street and Avenue D. (Rosenberg Library)



PHOTOGRAPH BY
 DIRECTOR OF UNION DEPOT,
 GALVESTON, TEX.

• *A glimpse of Galveston during the railroad era (Rosenberg Library)*

subsequently issued, but insufficient capital and the relatively small population of the region conspired to keep an operating line from becoming a reality until 1853, when the Buffalo Bayou, Brazos and Colorado line put its first locomotive into operation.²

That same year, the Galveston, Houston and Henderson Railroad received its charter for a road between Galveston and Houston. Work began on the mainland at Virginia Point, just across the bay from Galveston Island, in 1856. The following year, citizens of Galveston voted \$100,000 in bonds for construction of a 10,000-foot trestle to carry a railroad from Virginia Point to the island. The first train rolled across the bridge on February 9, 1860, affording the first direct rail connection between Galveston Island and the outskirts of Houston, some 40 miles away. This route was completed just in time to prove advantageous to the Confederacy during the Civil War.³

Not, however, until the period of Reconstruction did serious construction of railroads get underway in Texas. While Howell was struggling with his gabion jetties, the railroad craze was taking Texas by storm.

Rivalries for roads were intense; financial masterminds like the legendary Jay Gould bought and sold railroads while Wall Street reverberated from their cavalier transactions. Where Texas could claim but 711 miles of track in 1870, an extensive network of railroad lines stretched 3,257 miles across its vast expanses by the early 1880s. So rapid was this growth that four years later, in 1884, the state's track mileage had almost doubled to 6,166 miles.⁴

Even Galveston finally jumped into the act. The long-standing feud between Galveston and Houston grew progressively intolerable as Harris County slapped a series of yellow fever quarantines on Galveston, closing the island port and forcing its business to flow through Houston. Eventually came the quarantine that was one too many as far as the islanders were concerned. Incensed Galvestonians subscribed funds and obtained a charter in 1873 for a second railroad to the mainland — one that would bypass Houston! Local capital was used to “head off speculation and keep out outside influence.”⁵ Running 66 miles from Galveston to Rosenberg, where it met the San Antonio road, the new Gulf, Colorado and Sante Fe Railroad initiated service on December 22, 1879. Almost immediately came reports that the Galveston, Houston and Henderson was losing passengers to the new line. In a novel attempt to regain its patronage, the Galveston, Houston and Henderson rose to meet its competition with a “splendid inducement to the travelling public.” On January 1, 1880, the 5:15 train to Galveston “left the union depot with a brass band going at full blast as the train pulled out.”⁶

The railroad scramble provided a lively diversion, but it was merely the tip of the iceberg as far as Galveston was concerned. The port was the real lifeblood of the city and the Galveston Wharf Company was taking full advantage of it. As the only Gulf port of any consequence west of New Orleans, Galveston enjoyed a virtual monopoly on oceangoing commerce from those points in the interior that were not better served by the railroads to New Orleans. Fortunes were being amassed and the Galveston Wharf Company's grasping policies soon earned for it the epithet of “Octopus of the Gulf.” In 1859, while acknowledging that most of the profits were reinvested in wharf improvements, the company paid \$70,000 in dividends.⁷

Competitive efforts to undermine the wharf company's domination of the coast were futile. Two Texas ports offered only feeble challenge to Galveston's supremacy during the nineteenth century. Indianola Harbor on Matagorda Bay was established as a port in the early years of the Texas Republic. Its development was fostered by Commodore Charles Morgan, founder of the great steamship line that bore his name and became part of the Southern Pacific interests during the mid-1880s. Rivaling Galveston

as a center for German immigration, Indianola served as port of disembarkation for the camels imported for the ill-fated West Texas experiment. The hurricane that struck Lavaca Bay in 1875 inflicted extensive damage on Indianola, and the later fury of a storm in 1886 completed the job of removing all vestiges of the once bustling harbor.

The other port that emerged during these years was a fluke. An enormous log jam or raft caused the waters of the Red River to back up into its tributaries. In this fashion, Jefferson, a city northwest of Shreveport on Big Cypress Bayou, acquired deep water and enjoyed a successful interlude of port activity. The cotton of North and East Texas was transported from Jefferson to New Orleans. Jefferson became second to Galveston in the amount of Texas commerce it handled.

Pinning its hopes on the port, however, proved to be a disastrous error for this city. In 1873, army engineers from New Orleans succeeded in breaking up the Red River raft, causing the waters to recede slowly from the tributaries. Jay Gould approached Jefferson citizens to donate rights-of-way that would enable him to turn their city into a railroad center. The Jeffersonians spurned his overtures, failing to recognize the impending demise of their port as its waters gradually disappeared down the Red River. On January 2, 1882, Gould checked out of the Excelsior House in Jefferson for the last time, boldly inscribing in a flourishing hand on the hotel register, "End of Jefferson, Texas." His message turned out to be prophetic. Jefferson "dried up" and never again presented significant competition to other Texas ports.

Thus, the eyes of Texas and of points far beyond looked toward Galveston and, more specifically, toward the persistent outer bar that blocked navigational access to Texas and the greater Southwest. In 1840, Sheridan had noted, "The Bar never has as much as 15 feet upon it — 12½ & 13 being the average . . ."⁸ For the next forty years, deep-draft oceangoing vessels were forced to drop anchor in the Gulf and unload their cargoes onto shallow-draft lighters. The necessity for lighterage slowed the course of transport and the extra handling raised freight costs.

By 1880, the water over the outer bar had been deepened not a whit! Southwestern mercantilists, shippers, planters, and the citizens of Galveston — all had a vested interest in removal of the troublesome bar. Their determination was further nourished by the stunning accomplishment at the mouth of the Mississippi, where an 8-foot bar had obstructed passage to New Orleans and other ports on the mighty river. In the mere five years from 1874 to 1879, this bar had been scoured by the construction of jetties and a depth of 30 feet had been secured.⁹ Could not the same be done for Galveston? Demands grew more insistent around the state.

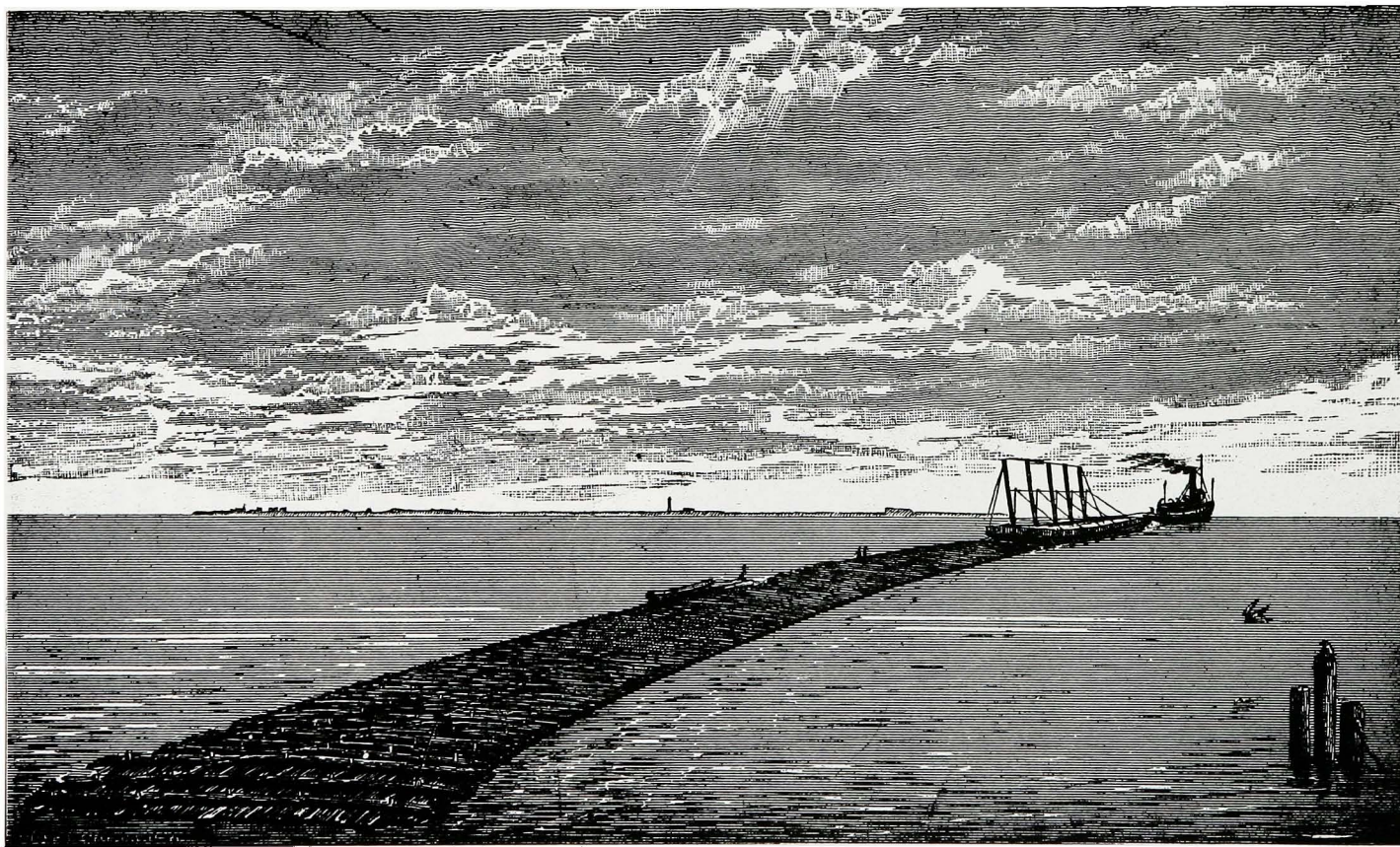


The Strand in 1891, looking east from Bath, later named Rosenberg, Avenue (Rosenberg Library)

The Galveston Engineer Office

Coupled with their impatience was the Galvestonians' eager anticipation of an engineer officer to take charge of the Texas Coast. On January 9, 1880, the *Galveston Daily News* reported that steps were being taken to locate a high-ranking engineer in Galveston. That same day, Maj. (later Brig. Gen.) Samuel M. Mansfield was ordered to relieve Howell of the works in Texas. Mansfield arrived in Galveston on February 25, 1880, to officially take over river and harbor improvements in Texas and to establish the Galveston Engineer Office, precursor of the present-day "Galveston District."¹⁰

The engineer assigned to direct the operations of the new Galveston Engineer Office was in his fortieth year and a well-seasoned officer. Son of the distinguished Maj. Gen. Joseph K. F. Mansfield, Samuel Mansfield had followed in his father's footsteps, graduating sixth in his class at West Point on June 17, 1862. Soon participating in combat operations for the



Mattress jetty construction in Galveston Harbor, 1882

Department of the Gulf, he later gained valuable experience in fort construction, harbor defenses, and river and harbor improvements.¹¹

In Galveston, Major Mansfield set up offices at Twentieth and Strand, the busy street named after the Strand in London and known as the "Wall Street of Texas" up until the turn of the century. His letterhead was elegantly imprinted "United States Engineer Office, Hendley Building."

Boundaries of the district for which Mansfield was responsible included all streams from the Sabine River to the Rio Grande. Mansfield promptly plunged into a number of projects up and down the Texas Coast. All had received some measure of attention under Howell's administration. Most had been examined and surveyed early in the 1870s and, by 1880, represented widely varying stages of progress.

Navigability of the Sabine and Neches rivers had been temporarily achieved and was being maintained by dredging and removal of obstructions. To maintain a 5-foot depth from the mouth of the Trinity River up to Liberty, dredging and snagging operations had been in progress since 1878. A project begun in 1871 now afforded a 9-foot-deep channel in Galveston Bay from the Gulf to the upper bay, from which ships continued on via Buffalo Bayou to Houston. Continuing on down the coast, the first appropriation was forthcoming in 1880 for construction of jetties at the mouth of the Brazos River. Still other proposals for jetty and groin construction at Pass Cavallo, Aransas Pass, and Brazos Santiago Harbor were ready to be launched. By the following year, Mansfield had begun work on them.

The most pressing matter was undoubtedly the outer bar at the entrance to Galveston Harbor. Thoroughly familiar with the project, Capt. C. E. L. B. Davis and Assistant Engineer H. C. Ripley were invaluable to Mansfield as he reviewed its history and planned a fresh attack on the impediment to this vital harbor. Desirability of the principle of a contracted channel remained unquestioned; how to achieve it was the problem. The board of engineers had advised switching from gabions to brush mattress and stone jetties, leaving construction details up to the engineer in charge. Accordingly, Mansfield experimented with different types and sizes of mattresses and prepared estimates for the north and south jetties which, depending upon the type of construction used, varied from \$1,825,813 to \$2,378,128. A 25-foot depth was anticipated from this improvement.¹²

The rivers and harbors act, passed on June 14, 1880, appropriated \$175,000 for the Galveston Harbor improvement. Largest single appropriation to date, this sum still fell short of the estimated amount that could be profitably used. Meanwhile, Mansfield placed a "trial section" of mattress work and concrete ballast, 90 by 60 by 2½ feet, at the outer

end of the Bolivar gabionade (or north jetty). He then concentrated on the south jetty, where he steadily proceeded to lay a 22,551-foot foundation of mattress work and stone ballast. This was built up with additional courses (layers) of similar construction which progressively diminished in size as the jetty rose higher. By the end of 1882, the foundation layer had been completed and a second layer was nearing completion. The jetty had at least two, if not more, layers to be added before it would reach the projected height. Between the beginning of 1880 and August of 1882, Congress had appropriated a total of \$825,000 for the Galveston Harbor improvement based on Mansfield's \$1,825,813 estimate.¹³

Early in 1883, the rivers and harbors bill failed to pass. Watching progress in the harbor with more than casual interest, Galveston citizens were well-aware of the consequences of this failure. On March 9, Roger L. Fulton, mayor-elect of the city, asked Mansfield some pertinent questions: how long could he carry on the work with the funds he had, what would happen to the works should he have to suspend operations for want of funds, and how long a suspension would be anticipated? He further queried: how much money would be required to keep the work going during the summer and, if it were continued, what probable difference in depth of water on the bar would be produced?¹⁴

Major Mansfield replied that with a reduced force, he might be able to "drag along" the work until some time in June. The jetty itself would not be harmed significantly by an interruption in work, but plant deterioration would be considerable. He estimated \$100,000 would keep the work going through the summer to complete the 4-mile south jetty to a height of mean low tide. He further stated, "I should be very much disappointed, however, if it did not result in a channel 18 feet deep by next fall." Still confident of the plan's eventual success, he added, "there is no engineering difficulty in the way; it is a mere question of dollars and cents."¹⁵

Acting with remarkable dispatch, Galveston city officials secured passage of legislation within a month. On April 7, 1883, the Texas legislature approved an act (H.D. 543) authorizing coastal cities to issue bonds for improvement of their harbors. Under this law, a city ordinance authorized issuance of \$100,000 in bonds yielding 5 percent interest "to aid in deepening water on the Galveston Bar." The funds were to be used by the army engineer in charge of the specified harbor improvement. By mid-May, Mansfield had been given authority from the chief of engineers and the secretary of war to receive the city appropriation. For the time being, continuance of the work was assured.¹⁶

Where Is That Eighteen Feet of Water?

By fall of the year 1883, anticipation was understandably running high for encouraging results from the jetty. Having underwritten the work, the citizens were busy giving harbor developments careful scrutiny, some even taking it upon themselves to take their own soundings of the depth over the bar.

On September 3, a scathing letter to the *Galveston Daily News* from Lorenzo C. Fisher was published, bearing the belligerent heading, "Where Is That Eighteen Feet of Water?" An inveterate letter writer and former mayor of the city, Fisher did not mince words:

The 1st of September, 1883, has come, and is now numbered with the past. Its arrival was not made memorable by the announcement in your columns that eighteen, or even fifteen feet of water had been secured on the bar. There was an absence of information on that subject in your local columns that day, which was ominous, and almost painful, to many people who had been taught to hope so much.¹⁷

Fisher ranted at great length and with considerable sarcasm on the shortcomings of the government efforts. He suggested in no uncertain terms that the "general" government stand aside and let other engineering talent take on the job of deepening the harbor.

In the days that followed, the *News* was deluged by letters. Thousands of words were printed and the paper was filled with articles, editorials, interviews, and letters, all hotly debating every conceivable ramification of the controversy. Whether qualified or not, each writer expounded his ardent opinion. Fisher inaccurately accused the army engineers of ignoring the destructive effects of the teredo navalis, a worm that plagues the Gulf Coast by feasting on exposed wooden beams. This charge was followed by a letter helpfully offering the latest defense in the fight against the pesky teredo, "a compound solution of pysolignous and carbolic acids."¹⁸ In fact, the government engineers had believed that sand would fill the interstices of the brush and protect it from the teredo.¹⁸

In the crosscurrent, Capt. Charles Fowler of the Morgan interests patiently explained the need for "a strong gale from the eastward" to fill the bay, "followed by a norther, driving the water out over the bar" to scour away the obstruction. Predicting a consequent gain of 2 or 3 feet, he declared, "then the croakers will cease to croak, and I look for such a



Looking east from Williams and McKinney wharf, 1884-90 (Rosenberg Library)

result as sure as I look for the sun to rise tomorrow.”²⁰ In response, Fisher ridiculed, “Is it seriously contemplated that in order to complete the present plan of harbor improvements the storm king is to be called in?”²¹ Indeed, Mayor Fulton sounded a trifle dubious when, in an interview reported on September 8, he stated:

When I recommended the appropriation of \$100,000 to aid in the undertaking I could not find one to find fault with the suggestion, but before one-half of the amount was expended the raven perches upon our door and croaks, “Nevermore.”²²

Even the most outspoken opponents of the government enterprise took pains to avoid inugning Mansfield personally. It appears that this officer conducted himself with the professional dignity befitting his rank and enjoyed considerable respect and acceptance by the local citizenry, despite the periodic assaults upon his work that permeated the daily newspaper.

Mansfield remained steadfast in his confidence that the jetty plan would result in success. In fact, not half of the money estimated for the jetty project had been expended, the north jetty remained to be built, and the

small, but steady, increments of increased depth had amounted to 2 feet already.

One contingent of local people rose to Mansfield's defense. Joining Captain Fowler, Capt. Jerry Sawyer of the Mallory Lines pointed to the progress already made, indicating that the 2 feet added to the depth over the bar was saving the Mallory Lines about \$2,250 on each full cargo by reducing the lighterage expenses.²³ More conservative citizens expressed disappointment and impatience, but were careful in their placement of blame for the failure:

The plan, for aught I know, may be a good one, and Colonel Mansfield is doubtless a good engineer. My objection is to the restricted method of the government dispensation of funds.²⁴

This attitude echoed the analysis that had frequently punctuated the news to the effect that, "There has been entirely too much dependence upon Congress for this class of work, and with unsatisfactory results."²⁵

A former state senator, Robert G. Street, joined the dissatisfied ranks of Fisher's camp and urged the city council to take the matter out of the hands of the army engineers and to "forthwith engage the first engineering skill in the land"²⁶ His innuendo, if it may be so considered, was far from subtle.

It was inevitable that the name of James B. Eads should crop up in discussions pertaining to the jetty issue. A self-made civil engineer, the unorthodox and controversial Eads had to his credit brilliant successes in the bridge spanning the Mississippi at St. Louis and in the opening of the South Pass of that river. Parallels to the situation at the South Pass were bound to be drawn. Eads had gone to enormous effort to secure sufficient financing to push his project through to successful completion, charging Congress afterwards predetermined sums according to each foot of depth achieved. "No water, no pay," was the formula upon which he had negotiated these works.

In an interview published October 16, Mansfield explained the differences between his situation and that under which Eads had labored:

The work of Captain Eads at the mouth of the Mississippi river is somewhat different. His problem was the improvement of the mouth of a river, mine the improvement of a tidal harbor. His jetties are about two miles in length, mine about four miles. He has received from the government about \$5,000,000, while differences in conditions of construction are alike wide apart. With his material close at

hand, with unlimited funds and smooth water enabling the work to go on uninterrupted, he has been enabled to attain success, while I have labored against difficulties that seemed almost impossible to surmount. Materials have come in slowly and our work is all out at sea, and the means for carrying it on have been inadequate to its rapid and proper conduct. We shall, however, having gone so far, now carry it through, for we have demonstrated beyond any question its entire practicability.²⁷

On one point, Mansfield and Eads were in perfect accord; both shared the sentiment that there was no engineering problem that could not be solved with the support of adequate financing.

The movement for Galveston to take more aggressive action was gaining momentum. On October 15, a resolution was introduced at the city council meeting to appoint a committee,

. . . for the purpose of procuring the services . . . of a civil engineer, or engineers of approved skill to make surveys, plans and estimates for obtaining deep water at this port.²⁸

A deep-water committee was named immediately. The following week, Alderman Norris Wright Cuney moved that the resolution to appoint the committee be reconsidered and amended, because he had heard the intimation that the previous action might be construed as an affront to the government engineer. He added that the committee should confer with Major Mansfield before taking final action. This resolution was postponed, however, and the matter was temporarily tabled.²⁹

Excitement over the deep-water committee and the prospect of approaching Eads overshadowed the announcement on October 28 that the British steamship *Prior*, drawing 15 feet of water, had crossed the bar and come to the Galveston wharves. This latest "triumph" topped the record of 14 feet 10 inches set by the *Empress* in October, 1882; but it attracted relatively little public attention, offset by a special article from New York two days later that reported Eads as being confident of securing results in Galveston and willing to undertake the work if called upon to do so.³⁰

"Is it Eads or Mansfield? the civil or the military engineer?" The *Houston Post* pitted one against the other and defined the extremes of the controversy, indicating that "the people of Houston have a stake in deep water here scarcely secondary to that of Galveston herself. . . ."³¹

The city council moved into action on Monday, November 5, 1883. With some rewording and assurance that Mansfield was not intended to be

slighted, the resolution was adopted that the mayor appoint a committee to communicate with Eads regarding the goal of a 20-foot depth across the bar. Mayor Fulton named a new committee. By Friday of the same week, a subcommittee had drafted a letter and submitted it for public endorsement by the mayor, city council, Cotton Exchange, leading corporations, and the commercial community at large.³²

Dated November 8, 1883, the letter asked Captain Eads: would he be willing to undertake the work of deepening the water on Galveston bar to the extent of 25 or 30 feet and, if so, how long would it take? how much would it cost? and for what per annum would he guarantee to maintain the depth agreed upon? The committee promised Eads cooperation in securing "the necessary congressional assistance."³³

The year had almost run out when Mayor Fulton received Eads's reply, written December 6 in London, where Eads was attempting to restore his frail health. Published in its entirety on December 28, Eads's letter stated he would be willing to undertake the work,

. . . if Congress would pass an act sufficiently liberal in its provisions to secure a rapid prosecution of the works, and . . . leave me untrammelled in their location and design, as well as in their construction, . . .

If he were allowed to work under conditions similar to those that obtained at the South Pass, he would secure "a permanent channel . . . not less than 30 feet deep at average high tide." Indeed, he indicated, with the current demands of waterborne commerce, a depth of less than 30 feet should not be contemplated by the city of Galveston. Allowing that the "problem presented is a much more complicated and difficult one than that at the mouth of the Mississippi," he proposed changing the location of the jetties and raising the height above high tide. Eads estimated a depth of at least 20 feet could be achieved within two years and about 2 or 3 feet each year thereafter until reaching a 30-foot channel depth. The greater magnitude of the Galveston jetties and the more exposed location of the works, which would increase danger of injury to the works and equipment, naturally raised the cost. Eads estimated \$7,750,000 and offered to guarantee the work for ten or twenty years at \$100,000 per annum.³⁴

Eads's proposal was embraced enthusiastically by the Texas legislators, citizens, and press. Work began on a bill to be submitted to Congress. Mansfield clipped Eads's reply and forwarded it to the chief of engineers in Washington. Late in January, 1884, he stated the necessity for an immediate appropriation. His plea was in vain; in fact, no funds were appropriated for improvements in Galveston Harbor during the four

years from August, 1882 until August, 1886, although other projects along the Texas Coast were funded.³⁵

On May 22, 1884, Eads appeared before the Rivers and Harbors Committee. He recommended 2,000 feet as a maximum width between the jetties, a considerably greater contraction of the channel than the 7,000-foot width adopted by the Corps would produce.³⁶

The bill embodying Eads's proposal was introduced in Congress in January of 1885. It stimulated several days of heated debate between the proponents of James Eads and those who took a dim view of the enormous sums this engineer had already extracted from the national treasury. Finally, an alternate provision was attached to the bill that Eads be hired as a designer or contractor and paid an annual salary of \$3,500 to conduct the work. As such, the bill was dropped into an omnibus rivers and harbors bill. In the end, an insulted Eads withdrew his proposal and the unfortunate rivers and harbors bill plummeted to defeat.³⁷

An examination of the south jetty made in June, 1885, showed that the average height had diminished by 5.77 feet or 61 percent. Lack of money and cessation of the work in 1883 had left no chance to cover the jetty with stones large enough to resist displacement. Prolonged exposure to ravages of the teredo and the wash of the breakers resulted in the more than 4-foot subsidence, caused by compression of the brush mattresses, destruction of top mats by wave action, and undermining by scour. The jetties had not settled bodily into the sand.³⁸

In January of 1886, a new board of engineers, consisting of Col. J. C. Duane, Lt. Col., Henry L. Abbot, and Lt. Col. Cyrus B. Comstock, was convened to review the issue of the Galveston jetties. Rapid growth of commerce since 1880 had increased depth requirements, adding somewhat to the problem; however, other circumstances had changed sufficiently to give the project a more favorable prognosis. Stone was now readily available at reasonable cost and considerable data had been gained from the previous experience in constructing the earlier jetties. The board found itself called upon less to study the details of jetty construction than to determine the general principles governing their location.³⁹

The board concluded there was little to be gained by building jetties closer together than 7,000 feet, but much to be lost. Greater channel contraction would lessen tidal oscillation, thereby increasing the risk to existing channels by diminished currents; it would also increase the danger of undermining the jetties themselves and the liability of Galveston Island to overflow in a storm. Therefore, the engineers settled upon a plan for converging jetties, 7,000 feet apart at their outer ends. The body of the jetty would be constructed of rubble stone, underlaid by a single brush mattress; the top of the jetty would rise 5 feet above mean low tide

and be capped with concrete. The rubble slopes were to be covered with heavy stone blocks, weighing from six to eight tons each, and the outer portion was projected as a solid concrete pier.⁴⁰

Maj. (later Maj. Gen.) Oswald H. Ernst replaced Mansfield in the Galveston Engineer Office on November 22, 1886. In later years, Ernst would assume the responsibility for public buildings and grounds in Washington, D.C. and serve as superintendent of the U.S. Military Academy. His distinguished career culminated in his appointment as president of the Mississippi River Commission in 1905.⁴¹

In addressing himself to the matter of the Galveston jetties, Ernst began work with \$300,000 appropriated by Congress on August 5, 1886, the first appropriation for this work since 1882. A contract was signed with A. M. Shannon & Company to raise the old south jetty. Beginning with stone and clay construction on the shore arm, work was resumed in July, 1887, ending a suspension of more than three years. Following another three-month interruption during the summer of 1888, a new \$500,000 appropriation enabled further progress. By August, 1890, the new south jetty extended over 19,000 feet from the corner of Avenue A and Ninth Street in the city of Galveston out into the sea. And, once again, funds were exhausted.⁴²

Deep Water at Last

Although jetty construction under the project adopted in 1886 reflected greater success than the earlier projects, progress remained slow. Little change had been realized over the outer bar. Fortunately, a combination of events occurred around 1890 to radically improve the outlook for deep water in Galveston Harbor.

The phenomenal development of the Midwest and Southwest during this period spurred the already widespread demand for a deep-water outlet on the Gulf Coast. Not only were the economic interests of the immediate area straining, but producers as far distant as California and beyond were handicapped by having no available port closer than New Orleans. The vital link envisioned across the isthmus of Panama, longed for by so many for so long, had bogged down in a morass of bankruptcy and disease. Calls for a deep-water harbor on the Texas Coast grew louder and more urgent than ever before.

In a sense, Howell's plea in 1871 had been prophetic. Although it fell on deaf ears at the time, the principle which prompted him to recommend not spreading the rivers and harbors appropriation too thin was being gradually embraced during the 1880s. An appreciation of the changing conditions of commerce was leading to the realization that railroad combines

and centralization of business were setting a new trend in the nation's growth. Fewer harbors, but bigger and better ones, became the new order of the day.

Beginning late in the decade, conventions were held in a number of interior cities — Fort Worth, Denver, Topeka, and Omaha — for the purpose of obtaining such a harbor to serve the greater Southwest. The first step was to select the most desirable location. A resolution was presented to Congress, requesting that a board of federal engineers be appointed to choose among the contending sites.

In response, Congress passed an act on March 2, 1889, directing the secretary of war to appoint three engineer officers to:

. . . make a careful and critical examination of the northwest coast of the Gulf of Mexico, west of ninety three degrees and thirty minutes west longitude, and report as to the most eligible point or points for a deep harbor, to be of ample depth, width, and capacity to accommodate the largest ocean-going vessels and the commercial and naval necessities of the country, which can be secured and maintained in the shortest time and at the least cost. . . .

An appropriation of \$2,000 was provided to cover the expenses incurred by this engineer board.⁴³

Three lieutenant colonels, Henry M. Robert, George Lewis Gillespie, and Jared A. Smith, were named. On May 6, these officers assembled in New Orleans to begin their whirlwind tour of the Louisiana and Texas Gulf Coast. After preliminary study of charts and surveys, they examined Sabine Pass, the entrance and harbor at Galveston, Aransas Pass, Brazos Santiago Harbor and Port Isabel, Pass Cavallo, and the mouth of the Brazos River. Along the way, they held public meetings and met with groups of businessmen whose interests would be served by the development of a particular port. When their inspections were completed, the engineers traveled inland to meet with citizens in San Antonio and with the governor at the state capitol in Austin. Returning to Galveston, the board adjourned on May 20 to allow its members time to digest the considerable amount of data they had collected.⁴⁴

The board of engineers reconvened in Philadelphia for a couple of days in September and again early in December to finalize its report. The engineers specified that, to be worthy of consideration as a deep-water harbor, a potential harbor must be:

. . . an inner harbor to which an entrance having a clear width of not less than 2,000 feet, a cross-sectional area of not less than

43,000 square feet, and a depth of not less than 30 feet for a width of 600 feet, can be secured and maintained.⁴⁵

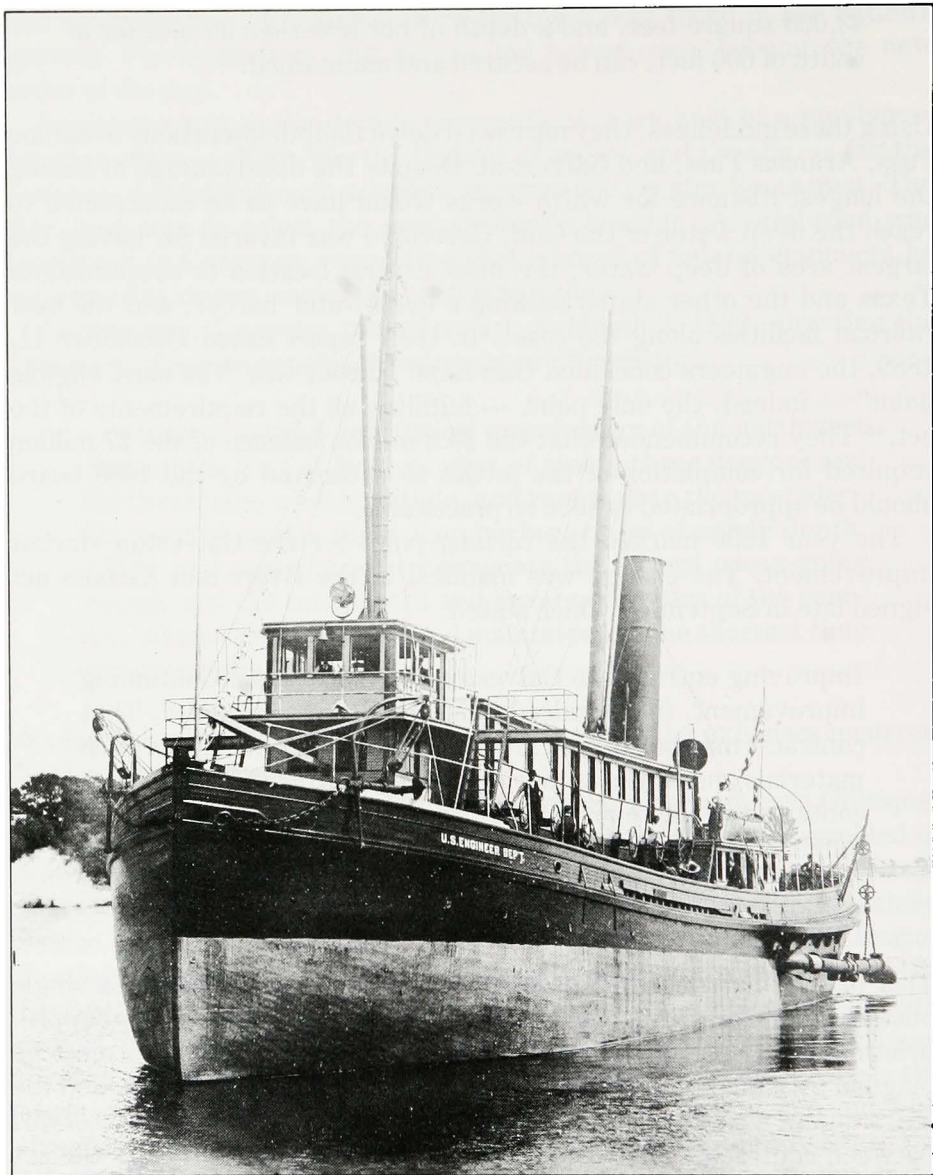
Using these guidelines, they narrowed down their deliberations to Sabine Pass, Aransas Pass, and Galveston. Despite the disadvantage of having the longest distance for which works would have to be constructed to reach the deep water of the Gulf, Galveston was favored for having the largest area of deep water, the most central location to accommodate Texas and the other states seeking a deep-water harbor, and the best railroad facilities along the coast. In their report dated December 11, 1889, the engineers concluded Galveston Harbor was "the most eligible point" — indeed, the only point — fulfilling all the requirements of the act.⁴⁶ They recommended that the \$6.2 million balance of the \$7 million required for completion of the jetties as estimated by the 1886 board should be appropriated as soon as practicable.

The year 1890 marked the turning point for the Galveston Harbor improvement. The change was manifest in the rivers and harbors act signed late in September which stated:

Improving entrance to Galveston Harbor, Texas: Continuing improvement, five hundred thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and works as may be necessary to carry out the plan contained in the report of the Chief of Engineers for eighteen hundred and eighty-six for the improvement of that harbor, to be paid for as appropriations may from time to time be made by law.⁴⁷

This provisional clause shot down what had been the greatest single obstacle to success, the cumbersome and costly policy of partial appropriations by Congress. No more would the Galveston jetty project be plagued by exhausted appropriations, repeated work stoppages, and the extravagant waste of incomplete works left to deteriorate in the intervals between contracts. This time it was understood that, although the act specified \$500,000, the larger sum of \$6.2 million (and still more if necessary) would be forthcoming and actually furnished as required to allow the work to proceed continuously to its completion. Galveston was jubilant.

From then on, the course of the Galveston jetties moved smoothly and rapidly. Maj. Charles J. Allen, who had relieved Major Ernst late in 1889, wound up the Shannon contract. With the assistance of General Comstock and other members of the 1886 board in preparing the specifications, he administered a new contract with the firm of O'Connor, Laing & Smoot which began work on the south jetty in August of 1891.



First self-propelled U.S. hopper dredge to work in Galveston Harbor, the General C. B. Comstock replaced the hydraulic dredge Jumbo, which had to be towed by tugboat. Equipped throughout with electric lights, the Comstock boasted hopper capacity of 600 cubic yards. The hoppers could be filled in 1½ hours and dumped in 8 minutes. This \$86,000 vessel, built in 1895, served the district until 1913.

Construction procedures were varied according to the nature of the different reaches in the jetty. Maj. Alexander Macomb Miller took over the district in the spring of 1893 and the final work was conducted under his administration.⁴⁸

The *Belgian King* crossed the outer bar drawing 24 feet 7 inches on May 16, 1897. In ten years, the depth across the bar had almost doubled. By 1898, the depth over the outer bar was 25½ feet and over the inner bar, 26 feet. The channel between the jetties had been straightened since 1895 by the new U.S. hopper dredge *Gen. C. B. Comstock*. Considered complete in 1897, the south jetty extended a length of 35,603 feet; the north jetty extended 25,907 feet.⁴⁹

Lt. William V. Judson, who served in Galveston under Major Miller until February of 1897, compared with no small measure of pride the aggregate length of the world's major jetties:

| | |
|------------------------------|--------------------------|
| Galveston | 61,500 feet |
| Mouth of Mississippi | 20,000 feet |
| Columbia River | 25,000 feet |
| Charleston | 34,000 feet |
| Sulina mouth of Danube | 8,400 feet ⁵⁰ |

Deep water had become a reality for Galveston at last! Over the ensuing years, assisted by periodic maintenance dredging and subsequent channel modifications, the jetties have served well the ports on Galveston Bay. In 1975, the ports of Galveston, Houston, and Texas City handled almost 78 million tons of cargo that passed through the Galveston jetty channel. But although the dream of deep water for Galveston had been fulfilled with completion of the jetties in 1897, undreamed of changes were in store for the Texas Coast with the turn of the century.

Notes to Chapter 2

- ¹. *Galveston Daily News*, 1 January 1880.
- ². Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), pp. 35, 62-63.
- ³. Robert A. Nesbitt, *Rails onto Galveston Island: A Very Brief History and Eleven Prints of Locomotives, Interurbans and Maps* (Galveston: Port of Galveston, 1974).
- ⁴. S. Misc. Doc. 111, 48th Cong., 1st sess. (1884), p. 7.
- ⁵. *Galveston Daily News*, 1 January 1880.
- ⁶. *Ibid.*, 2 January 1880.
- ⁷. Earl Wesley Fornell, *The Galveston Era: The Texas Crescent on the Eve of Secession* (Austin: University of Texas Press, 1961), p. 18.
- ⁸. Francis Sheridan, *Galveston Island: The Journal of Francis C. Sheridan 1839-1840*; ed. Willis W. Pratt (Austin: University of Texas Press, 1954), pp. 44-45.
- ⁹. Florence Dorsey, *Road to the Sea: The Story of James B. Eads and the Mississippi River* (New York and Toronto: Rinehart & Company, Inc., 1947), pp. 178, 215.
- ¹⁰. Adjutant General's Office, Special Order (SO) 6, 9 January 1880; *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1880* (Washington, D.C.: Government Printing Office, 1880), pp. iii, 1205 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).
- ¹¹. George Washington Cullum, *Biographical Register of the Officers and Graduates of the U.S. Military Academy at West Point*, 3d ed., rev. and ext. (Boston and New York: Houghton, Mifflin and Company, 1891), 2: 849-50.
- ¹². *ARCE*, 1880, p. 1218; William V. Judson, "Report on Galveston Harbor" (Typed report, [1897]), p. 14, Galveston District Installation Historical Files.
- ¹³. *ARCE*, 1883, pp. 1059-60.
- ¹⁴. *Ibid.*, p. 1062.
- ¹⁵. *Ibid.*, p. 1063.
- ¹⁶. *Ibid.*, pp. 1067-69.
- ¹⁷. *Galveston Daily News*, 3 September 1883.
- ¹⁸. *Ibid.*, 3 September 1883; 11 September 1883.
- ¹⁹. Judson, "Report on Galveston Harbor," p. 14.
- ²⁰. *Galveston Daily News*, 6 September 1883.
- ²¹. *Ibid.*, 1 October 1883.
- ²². *Ibid.*, 8 September 1883.
- ²³. *Ibid.*, 17 October 1883.
- ²⁴. *Ibid.*
- ²⁵. *Ibid.*, 14 September 1883, quoted from *New York Maritime Register*.
- ²⁶. *Ibid.*, 5 October 1883.
- ²⁷. *Ibid.*, 16 October 1883.
- ²⁸. *Ibid.*
- ²⁹. *Ibid.*, 23 October 1883; 24 October 1883.
- ³⁰. *Ibid.*, 28 October 1883; 30 October 1883.
- ³¹. *Ibid.*, 2 November 1883, quoted from *Houston Post*.
- ³². *Ibid.*, 6 November 1883; 9 November 1883.
- ³³. *Ibid.*, 9 November 1883.
- ³⁴. *Ibid.*, 28 December 1883.
- ³⁵. Dorsey, *Road to the Sea*, p. 279; Docs. 13 and 339, Record Group 77, Letters Received, National Archives, Washington, D.C.
- ³⁶. Judson, "Report on Galveston Harbor," pp. 19-20.

- ³⁷. Dorsey, *Road to the Sea*, pp. 279-80.
- ³⁸. *ARCE*, 1886, pp. 1321, 1315-16.
- ³⁹. Judson, "Report on Galveston Harbor," p. 17.
- ⁴⁰. *ARCE*, 1886, p. 1307; Judson, "Report on Galveston Harbor," p. 19.
- ⁴¹. Judson, "Report on Galveston Harbor," p. 24; U.S. Military Academy Association of Graduates, *Annual Report*, June 1926, p. 173.
- ⁴². Judson, "Report on Galveston Harbor," pp. 24-25.
- ⁴³. Act of Congress of March 2, 1889, ch. 411, 25 Stat. 939.
- ⁴⁴. Corps of Engineers Headquarters, SO 29, 16 March 1889; *ARCE*, 1890, pp. 1781-82.
- ⁴⁵. *ARCE*, 1890, p. 1793.
- ⁴⁶. *Ibid.*, p. 1796.
- ⁴⁷. Rivers and Harbors Act of September 19, 1890, ch. 907, 26 Stat. 426.
- ⁴⁸. Judson, "Report on Galveston Harbor," pp. 30-31.
- ⁴⁹. *ARCE*, 1897, p. 1796; *ARCE*, 1898, p. 1492.
- ⁵⁰. Judson, "Report on Galveston Harbor," p. 35.

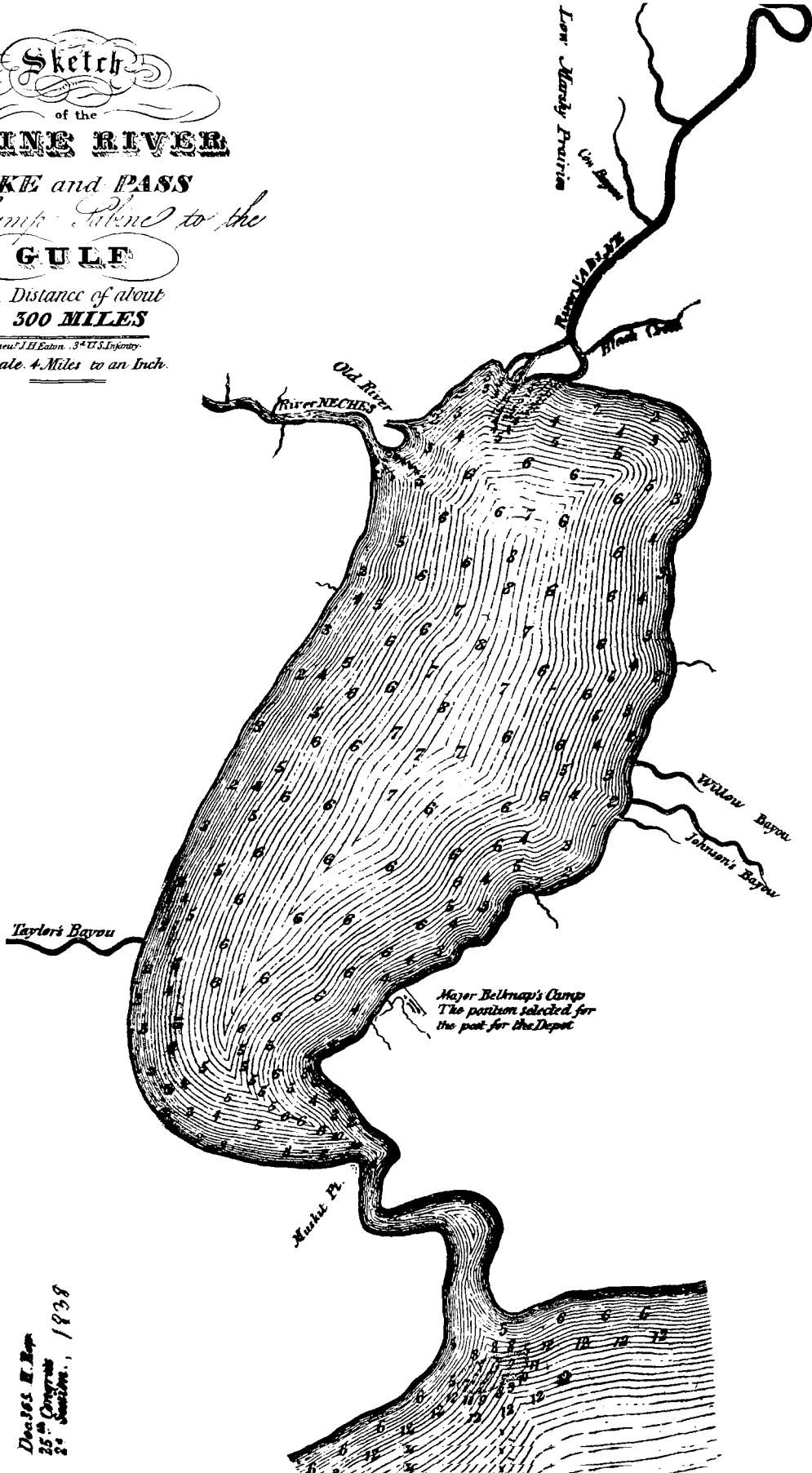
Sketch
of the
SABINE RIVER

LAKE and PASS
from Camp Sabine to the
GULF

A Distance of about
300 MILES

Lieut. J. H. Eaton. 3^d U. S. Infantry.

Scale. 4 Miles to an Inch.



*Drawn by H. B. Map
25th Congress
2^d Session, 1838*

Transformation of the Sabine

The Sabine River flows along the eastern border of Texas, joining the waters of the more westerly Neches River in Sabine Lake. Assigned to the Galveston District continuously for more than the last half century, these rivers changed hands a number of times in prior years and their early development involved several army engineer districts. The Sabine-Neches Waterway ranks unique among Galveston District channels in many respects, but particularly in that other districts accomplished its deep-draft conversion. Nevertheless, this waterway has received substantial improvement by the Galveston engineers and its story properly belongs in this district's history. Preceding the other streams in Texas as United States territory, the Sabine River was the first to be examined by army engineer officers.

The Disputed Boundary

At the time of the Louisiana Purchase in 1803, the valuable area known today as the Texas Coast was considered of such meager significance that the treaty failed to specify precisely the southwestern boundary; President Thomas Jefferson was prompted to wonder whether the newly acquired territory extended to the Sabine River or to the Rio Grande. Since neither Spain nor the young United States was prepared to defend Texas, the coast passed the next sixteen years largely unclaimed except by privateers and renegades.¹

An indirect report suggests how little the engineers knew of Texas geography as late as 1838. Early that year, under the command of Maj. W. G. Belknap, an expedition of the Third Infantry camped on the southwest bank of Sabine Lake and removed a raft which had obstructed navigation on the Sabine River. According to Isaac Wright, captain of the steamboat *Velocipede*, the result was "success beyond the expectations of the oldest inhabitants of the river," enhancing the value of "all lands adjacent to the river at least two hundred per cent." This improvement enabled Captain Wright to navigate the river 300 miles inland to Camp Sabine and back without injury to his boat, which carried 143 tons and

Opposite page: Lower portion of Lieutenant Eaton's drawing of Sabine River, Lake, and Pass, 1838

drew 5 feet of water. He estimated that freight from Natchitoches to Camp Sabine, previously costing five or six cents per pound, would be reduced to a mere two cents per pound for the longer journey from New Orleans to Camp Sabine via the newly opened Sabine River route.²

Lt. J. H. Eaton of the Third Infantry sketched the river from Camp Sabine to the Gulf of Mexico. Transmitting this drawing along with his report to his commander in Washington, Major Belknap noted:

The chart of the lake and pass you will find to be somewhat different from the one furnished me from the Engineer department. This, however, is correct . . . made . . . after a most careful and minute examination.³

Presumably, the "erroneous" Engineer Department chart was one of the maps, compiled in department headquarters, which incorporated all available information and existing knowledge. Held by Spain until 1821, Mexico until 1836, and the Texas Republic until statehood in 1845, Texas had little opportunity to receive direct scrutiny by the army engineers. Questions over the boundary would change this, however, and topographical engineers would soon be called in to view the region firsthand.

As control of Texas passed through successive governments, the Sabine River boundary grew into a chronic muddle. When Louisiana assumed statehood in 1812, its western boundary was described as the middle of the river, including all islands. Problems arose for the United States, first with Spain, next with Mexico, then with the Texas Republic, and still later with the states of Texas and Louisiana. An 1819 treaty between the United States and Spain fixed the boundary along the western bank of the Sabine River from the Gulf to the thirty-second parallel north, continuing due north to the Red River which it followed west to the one hundredth meridian. This boundary, however, failed to definitively resolve the issue.⁴

The Spanish treaty was succeeded by a new treaty, executed between the United States and Mexico on January 12, 1828. This treaty was considered binding upon Texas after the Republic declared its independence from Mexico. In 1839, a joint Texas-United States commission was appointed to survey the boundary between these two nations. Maj. James D. Graham was assigned to satisfy the desire of President Martin Van Buren

. . . that the commission should have the benefit of the advice and assistance of an officer of the United States corps of

Topographical Engineers, skilled in the science of astronomy and surveying.⁵

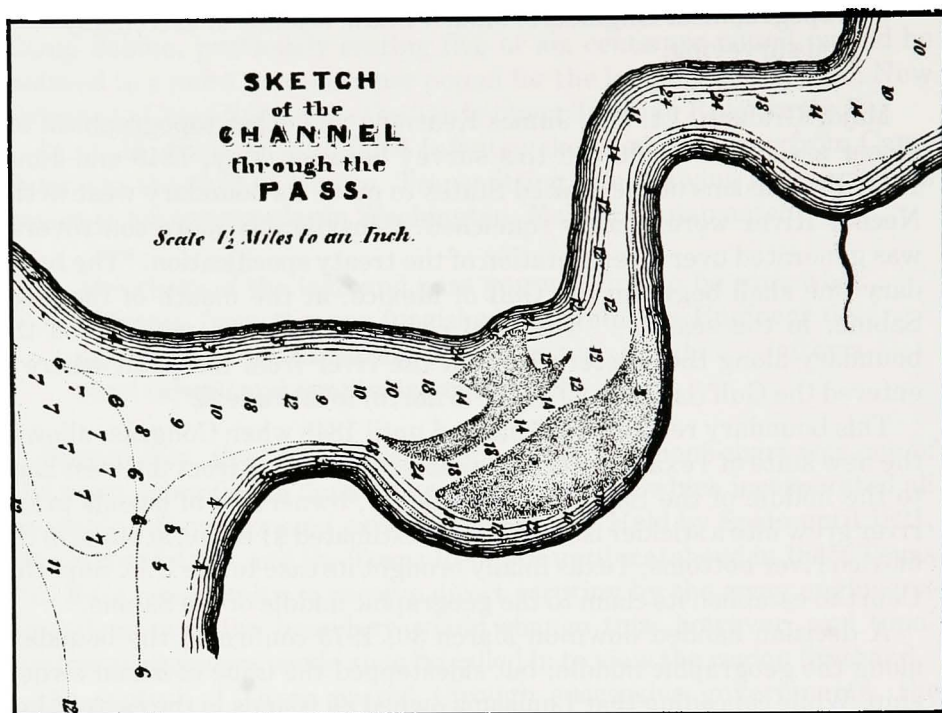
Major Graham, Lt. Col. James Kearney, and other topographical engineer assistants conducted this survey between May, 1840 and June, 1841. Pretensions of the United States to move its boundary west to the Neches River were quickly squelched. Considerably more controversy was generated over interpretation of the treaty specification, "The boundary line shall begin on the Gulf of Mexico, at the mouth of the river Sabine, in the sea. . . ." The final commission report established the boundary along the western bank of the river from the point where it entered the Gulf (latitude 29°41'27".5 north) to latitude 32°.⁶

This boundary remained unchanged until 1848 when Congress allowed the new state of Texas to extend its eastern boundary from the west bank to the middle of the Sabine. Subsequently, ownership of islands in the river grew into a stickier issue. With an estimated \$1 billion at stake in the oil-rich river bottoms, Texas finally brought its case to the U.S. Supreme Court to establish its claim to the geographic middle of the Sabine.⁷

A decision handed down on March 30, 1973 confirmed the boundary along the geographic middle, but sidestepped the issue of island ownership. While conceding that Louisiana owned all islands in the eastern half of the river, the court withheld judgment regarding those in the western half.⁸ Further proceedings must determine United States claims to these islands and settle the question of which islands existed before, or were created after, 1812. As the agency most responsible for modifying the river, the Corps of Engineers has been asked to furnish evidence in the recent proceedings.

Early Harbor Improvements

Annexation of Texas brought the state's navigable streams into the province of the army engineers. Lt. Henry L. Smith, under orders from New Orleans, surveyed the Sabine River in 1853. He found the adjacent country abundant with "wild game, such as ducks, geese, wild turkeys, deer, and bears" and blessed with good soil which "produces fine crops of cotton, corn, potatoes, &c." Shoaling, narrowing, and snags in the river presented such hazards to navigation that the "more tedious, but more certain" route via the Red River was preferred for transporting the region's cotton. Smith was informed that much of the lumber that supplied a large portion of Texas had traveled down the Sabine River, but the obstructions he noted would make difficult descent of the rafts. He recommended improvements to permit navigation along the river's lower 178



Sabine Pass as drawn by Eaton in 1838

miles year-round and along its total 738-mile length for seven months of the year.⁹

In Sabine Harbor, Smith found a tortuous channel; he proposed dredging a new, more direct channel 9 feet deep. Although the bar at the entrance to Sabine Pass had little more than a 5-foot depth at low water, its soft mud composition rendered it a less formidable obstruction than other bars along the coast and one which "a steamship can readily pass drawing ten feet." He advised no improvement of this bar.¹⁰

Twenty years later, Lt. H. M. Adams concurred after resurveying the bar and the pass under Captain Howell's direction. He found the channel across the soft mud bar 6 to 6½ feet deep. In 1875, however, Howell advised dredging it to at least 12 feet. A \$20,000 appropriation began an expenditure exceeding \$160,000 on dredging operations from 1875 to 1881. The U.S. dredge *Essayons*, assigned to the New Orleans Engineer Office, was put to work at the pass in 1877. She had about half completed a channel 12 to 15 feet deep when her boilers went out and she was laid up for repairs. Meanwhile, the *McAlester* was scheduled to carry on the work; however, in a disastrous attempt to reach Sabine Pass from the

Mississippi River, this ship was lost in January, 1878. The *Essayons* returned for more dredging, retired for more repairs, and returned again to Sabine Pass in September, 1880.¹¹

When the Galveston Engineer Office was established in February, 1880, the Sabine and Neches rivers were placed within its boundaries. In mid-June, 1881, improvement of these waters was assigned to Capt. C. E. L. B. Davis, who at that time transferred out of Galveston. Davis reported directly to the chief of engineers; during the four-month interval of his assignment there, the Sabine River belonged neither to the Galveston nor to the New Orleans office.¹²

Soon after his arrival at Sabine Pass, Captain Davis described problems with the *Essayons*. While conditions at the mouth of the Mississippi River had favored her use there, at Sabine Pass the dredge encountered many problems. Expensive to operate, she would either get stuck in the bottom or caught in crosscurrents and carried across the channel. The most propitious time for her to work was at night. Carefully detailing his reasons, Davis proposed that jetties be constructed and the *Essayons* be laid up at Algiers, Louisiana. To strengthen his recommendation, he added:

Another reason for laying her up is that her remaining idle here so much of the time has a bad effect upon the people interested in the improvement of this Pass who cannot understand why a boat with such a large crew is not constantly at work.¹³

Although the *Essayons* had received costly repairs before being sent to Sabine Pass in September of 1880, Davis found her debilitated and "liable to become disabled at any moment." Late in July, 1881, he ordered her to cross the bar while she still could and continue on to New Orleans for repairs. In a long letter to the chief of engineers, Davis requested approval for this action, indicating his reasons for avoiding delay and noting, "I find it generally takes about 16 days to get an answer to communications sent to Washington from here."¹⁴

The Engineer Department appears to have initially authorized preliminary repair work; however, instructions from the chief on September 22 put a halt to further repairs. On October 23, responsibility for the works on the Sabine and Neches rivers reverted to the New Orleans Engineer Office under Capt. William Henry Heuer.¹⁵ Almost forty years would pass before this waterway would be returned to the Galveston District.

The soft mud composing the bar continued to make dredging a losing proposition. Captain Heuer addressed himself to the matter of costly

dredging in a channel that "if left alone, would fill up again." Echoing Davis, he proposed constructing stone and brush jetties, beginning on the west side of the pass. The board of engineers convened in 1882 viewed favorably his proposal, preferring high rather than submerged jetties and omitting openings at the shore end as Heuer had suggested. Contract work on the west jetty began in January of 1883, followed within two years by work on the east jetty. The east jetty was completed to a height of 5 feet above mean low Gulf level and a length of 25,270 feet in March, 1920. The west jetty was completed to a length of 21,860 feet in May, 1929.¹⁶

Heuer had stated that high jetties placed 1,000 feet apart might afford a depth of 26 or more feet, which "fortunately Sabine Pass does not require . . ."¹⁷ The future of this waterway and characteristics of the commerce that would later travel over it were still unanticipated in 1896, when it was reported,

The commerce of the pass at this time is almost altogether in the shipment of pine lumber to coastwise and foreign ports, to wit 45,122 tons valued at \$172,681.¹⁸

The only projection on the horizon was based on completion of two railroads that purported to transform the pass into "a great grain shipping and importing port." One of these roads had already located its terminal point at Port Arthur,

. . . a part of its plan being to dredge a channel of sufficient depth to permit vessels to come from the pass and land at its wharves.¹⁹

The Troublesome Canal Permit

In April, 1897, the Kansas City, Pittsburg [sic] and Gulf Railroad together with the Port Arthur Channel and Dock Company began excavating a channel, 25 feet deep by 75 feet wide, along a 7-mile stretch from Sabine Pass to the new city of Port Arthur. The 7 miles from the Gulf to Sabine Pass had already received a \$3 million improvement by army engineers, the jetties having produced a channel depth of 25 feet. To connect these waters at Sabine Pass with those of Taylors Bayou at Port Arthur, the Port Arthur Ship Canal was to be dug primarily inland, just inside the west shore of Sabine Lake.

The Port Arthur Channel and Dock Company started dredging operations without securing permission from the War Department, apparently assuming none was necessary. When this deficiency was brought to its

attention, the company promptly requested permission to continue work. The processing of this request had a decidedly informal flavor.

On May 7, 1897, Chief of Engineers Brig. Gen. John M. Wilson wrote the dock company:

GENTLEMEN: In view of the fact that the Secretary of War has been informed that you propose to construct the canal to Port Arthur entirely inland, he directs me to say that while granting no authority he will no longer prevent the progress of the work, provided no materials are dumped in Sabine Lake nor placed upon the banks where they can be washed into the lake.²⁰

On August 30, Wilson indicated this letter constituted his office's "only official record of the action of the Secretary of War in this matter."²¹

An injunction brought against the company in late August, 1897 alleged it had not obtained proper permission. J. McD. Trimble, president of the dock company, wrote Secretary of War Russell A. Alger:

This allegation you will at once recognize as untrue. You will remember that on the morning of May 14, 1897, as you were about to leave Washington for Philadelphia, . . . you told me that we might be authorized by your permission to connect our canal with the deep water in Sabine Pass, and also in Taylors Bayou. . . .

Afterwards, but on the same day [May 14], I wrote you a letter which you received upon your return from Philadelphia, in which I stated the substance of your said permission and advice. A reference to that letter may serve to refresh your memory in case the flood of subsequent affairs tend to efface your impressions.

. . . I would be obliged if you would give . . . some affirmative evidence of your permit as expressed to me, so that I will not have to depend solely upon my own testimony to establish the fact.²²

In a terse communication dated September 9, Alger verified the correctness of the permission stated in Trimble's letter of May 14. The status of the law at that time, if anything, fostered the awkward exchanges and ambiguities that accompanied this permit issue.²³

Historically, under the commerce clause of the Constitution, the federal government claimed the right to assure free navigation in the nation's waterways. At a theoretical level, this claim was acceptable; however, in practice it tended to break down. To what extent could the Corps of Engineers exercise control over navigable waters? When and how could this control be enforced? In the final decade of the nineteenth century, legislation was just being introduced to define more specifically the appropriate role and powers of the Corps in protecting the waterways.

The law under which the Port Arthur company sought permission was contained in section 3 of the 1892 rivers and harbors act, an amendment and reenactment of section 7 in the 1890 act. This legislation made it unlawful to build certain structures that would "obstruct or impair navigation . . ." or to excavate or fill so as "to alter or modify the course, location, condition, or capacity" of any port, harbor, or navigable waters of the United States without approval and authorization from the secretary of war.²⁴ The people at Sabine Pass, an established settlement dating back to the 1839 "City of the Pass," strongly opposed the canal scheme, contending that sand and silt stirred up by the dredging would travel downstream and impair their harbor. These interests further claimed the secretary of war did not have authority to grant permission for construction of this canal.²⁵

For these and possibly for additional reasons related to the nature and magnitude of the canal, Chief of Engineers Wilson questioned whether or not the 1892 law applied in this situation. Was this, he asked, a work which the secretary of war was empowered to authorize? In response, Secretary of War Alger passed the query along to the attorney-general, whose office replied:

Without assuming to decide whether or not a "canal" is one of the works provided for in section 7, I am of opinion that if it is[,] the Secretary of War has the authority under the act of July 13, 1892, to authorize and permit its construction.²⁶

Aside from these legal technicalities, a more practical question pertained to the by-products of the new channel. Concerned parties speculated that the excavated material deposited east of the canal on the shore of Sabine Lake would be vulnerable to extensive erosion. Sabine Pass interests feared this material would be carried down into the pass, where it would clog the channel. Maj. James B. Quinn, who now headed the New Orleans Engineer Office, proposed placing sheet piling on the lake side of the canal, 1,000 feet from its center, to contain the dredged material and thereby safeguard the works at Sabine Pass. Col. (later Brig. Gen.)

Henry M. Robert, Southwest Division engineer, was called in to inspect the works and the plan. Robert reported it "improbable" that the proposed canal, "if properly built, should seriously obstruct or lessen depth of Sabine Pass Harbor."²⁷

Plans for the canal were approved by mid-1898. House of Representatives Document 549, Fifty-fifth Congress, Second session, containing the plans submitted by the Kansas City Railroad engineer, constituted the permit for the Port Arthur Ship Canal. The \$1,023,982.85 canal was completed in 1899, interestingly enough, the same year Congress legislated strong and precise powers with which the federal government could protect navigable waters.²⁸

Oil: A New Dimension

From the time of the first sawmill at Nacogdoches in 1819, milling and exportation of lumber composed the backbone of East Texas economy. After the Civil War, some diversification was introduced and agricultural pursuits on a scale larger than subsistence farming were initiated. Irrigation projects, construction of cottonseed oil mills, and experimental rice farming offered some economic variety, but these innovations were decidedly subordinate to the lumber factor.²⁹

An event on a salt dome south of Beaumont dramatically altered the region's economy and changed the course of development along its waterway. For several years, test drilling had been conducted at the Spindletop oil field. On January 10, 1901, the Spindletop well "came in" with a spectacular "gusher" which ran wild for several days before being capped. Along with the petroleum industry blew in a new future for the navigable waters along the Texas Coast.³⁰

Located near the site of petroleum production, the Sabine and Neches rivers were destined for rapid and substantial growth to accommodate the new industry. In 1902, Congress provided for preliminary examination of a ship channel from Sabine Pass, connecting with the Port Arthur Canal and continuing along the west shore of Sabine Lake, to the mouths of the Neches and Sabine rivers and on to Beaumont and Orange, respectively. In 1904, the Board of Engineers for Rivers and Harbors determined that a 9-foot deep channel would be adequate. Estimated to cost \$536,500, construction would be conditional upon transfer of the Port Arthur Canal to the United States, free rights-of-way along the remainder of the waterway, and provision for early completion under the continuing contract system. The board rejected a 25-foot channel depth, believing that potential commerce in oil, lumber, or other commodities would not benefit "to an extent commensurate with the cost."³¹

The 9-foot Sabine-Neches Canal project was adopted by Congress in 1905. Late that year, owners of the land bordering Sabine Lake offered to donate rights-of-way, provided the channel be constructed inland along the lake shore from the Neches River to Taylors Bayou. While deed transactions were taking place, work began March 1, 1906 at the Sabine River end of the canal, in the lake where no rights-of-way were required. By the end of June, a 20,476-foot distance from the mouth of the Sabine to the mouth of the Neches had been dredged.³²

The federal government acquired the Port Arthur Canal, lumber basin, turning basin, and a strip of land along the canal, free of cost, under provisions of a congressional act approved June 29, 1906. The secretary of war accepted the deed of conveyance from the Port Arthur Channel and Dock Company on December 13, 1906, making this canal a public water of the United States and a vital link in the Sabine-Neches Waterway. Responsibility for maintaining and operating this property shifted to the Corps of Engineers.³³

Extension at the southern end of the 9-by-100-foot barge channel to a junction with the Port Arthur Canal was authorized in 1907 and completed the next year. By 1909, commercial growth was so great that interests along the new Sabine-Neches Canal clamored for a 25-foot depth; shippers at Port Arthur and Sabine were pushing for 29 to 30 feet between the jetties.³⁴

The Dallas District

As the waters along Sabine Lake were just beginning their dramatic transformation, an organizational change altered the boundaries of the Galveston District. On August 4, 1905, a second district was established in Texas.³⁵ The new Dallas District carved its work load out of responsibilities formerly assigned to several older districts, encompassing the Trinity River, Cypress Bayou, and the Red River between Fulton, Arkansas and Denison, Texas, including the Sulphur River. Trinity River was acquired from the Galveston District; the balance of these works was transferred from a district in charge of "improvement of certain rivers and waterways in Louisiana, Texas, Arkansas, Indian Territory, and Mississippi Tributary to Mississippi River."³⁶ On April 9, 1907, the Brazos River, from Velasco to Waco, was reassigned from Galveston to Dallas. The following year, New Orleans relinquished the Sabine-Neches Waterway.

With acquisition of the Sabine and Neches rivers on April 1, 1908, the Dallas District entered a spectacular era of growth along this waterway. To handle the increased activity upstream, the suboffice moved from



Port Arthur Area Office under construction, 1910

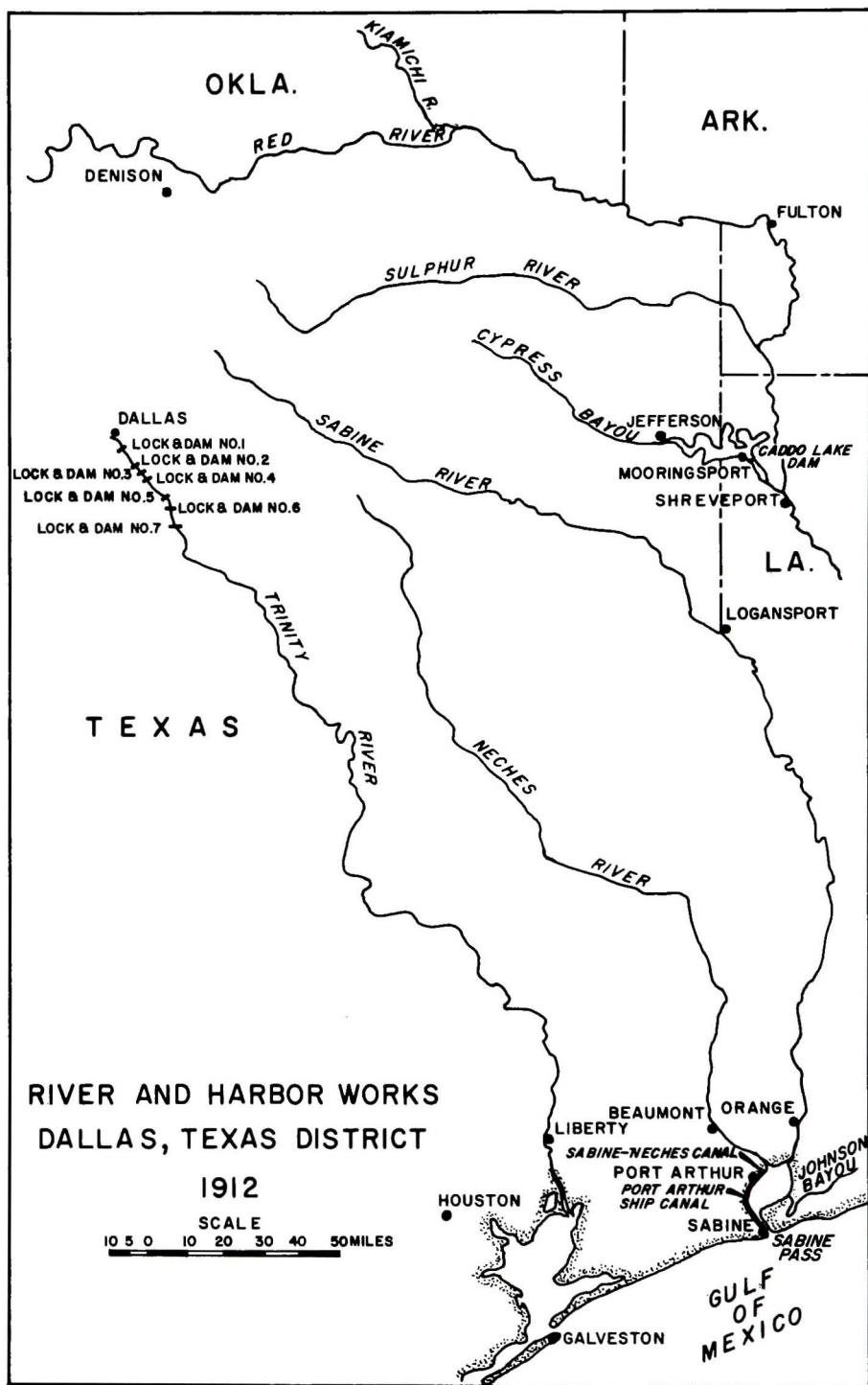
Sabine to Port Arthur. During 1909, the district spent \$5,001.62 to construct an office building on the lake side of the Sabine-Neches Canal, opposite Port Arthur.³⁷ Conditions had indeed changed from those prevailing in 1881, when the New Orleans engineer wrote the chief of engineers:

General:

The Engineer office at Sabine Pass now consists of two very small rooms for which we are paying \$10. per month. I respectfully request authority to pay \$5. additional viz \$15. in all for the rent of the building. This will give us two additional rooms and control of the building.

We shall then not have any more room than is absolutely necessary.

Very respectfully,
Your Obed't Servant,
W. H. Heuer
Capt. Engrs.



Impressive advantages accrued from the improved waterway. From 1908 to 1909, the value of cotton moved through Sabine Harbor doubled and sulphur shipments increased by nearly 25 percent. Accounting for well over half the commercial volume in value, petroleum and its products made up 78 percent of the gross tonnage.³⁹

Still, reservations were entertained as to whether future commerce along the Sabine and Neches waters would justify the considerable improvements being sought. By 1909, navigation districts in Beaumont and Orange had set their sights on a channel 25 feet deep. A preliminary examination and survey authorized that year drew unfavorable conclusions on proposed deep-draft improvements above Port Arthur. The rivers and harbors act in 1910 provided for reexamination.⁴⁰

Lt. Col. (later Maj. Gen.) Lansing H. Beach, who had served in Galveston in the early 1890s and would later become chief of engineers, headed a special board of engineers responsible for reconsidering the 25-foot project to Beaumont and Orange. At this point, these two cities were prepared to furnish \$571,500, half the estimated expense of \$1,143,000. On September 22, 1910, the board held a public hearing in Beaumont.⁴¹

Perhaps in response to demands of the rapidly growing commercial competition in Texas, Colonel Beach employed a literary analogy to clarify the board's position and explain some economic facts of life to those assembled:

The United States take care of waterways, but it is in the position of Mr. Wilfer in Dickens' story of our amiable friend. There are so many children to be provided for, that even rich as Uncle Sam is, he does not have money to provide for all of them at the same time. You remember Mr. Wilfer never had a whole suit of clothes at once. He could get a hat at one time, and a pair of shoes at another, and a third time he could get a coat, but there was never money enough to entirely outfit him at one time. Now, of course, you do not see that feature of the case. I think our friend, the Hon. Mr. Burgess, can tell you the demands that are made upon Congress for river and harbor works, and how and why it is necessary for the Government to discriminate. In that connection, I desire the people of Beaumont and Orange to understand the position of engineer officers upon that question. Our action is guided and limited by law. Congress authorizes preliminary examinations and surveys for rivers and harbors that give promise of developing commercial importance, but on account of the great demands of the various rivers and ports, it exacts the condition that

there shall be either present commerce or prospective commerce sufficient to justify the expenditure.⁴²

The Texas Railroad Commission representative described at great length the "Galveston differential," a charge levied on rail traffic moving from the Texas interior to its seaports. Colonel Beach established that extension of deep water inland to Beaumont and Orange would eliminate this differential, thereby reducing freight rates on all commodities.⁴³

Congress authorized deep water from Port Arthur along the Sabine-Neches Canal and on up the respective rivers to Orange and Beaumont in 1911. Further legislation in 1912 allowed for cutting off bends along the rivers and widening channels. The new, deep-water Sabine-Neches Waterway was completed by 1916. Soon, the "District of Sabine Deep Waterway" (the combined Port Arthur, Beaumont, and Orange navigational interests) ranked first among the nation's oil ports.⁴⁴

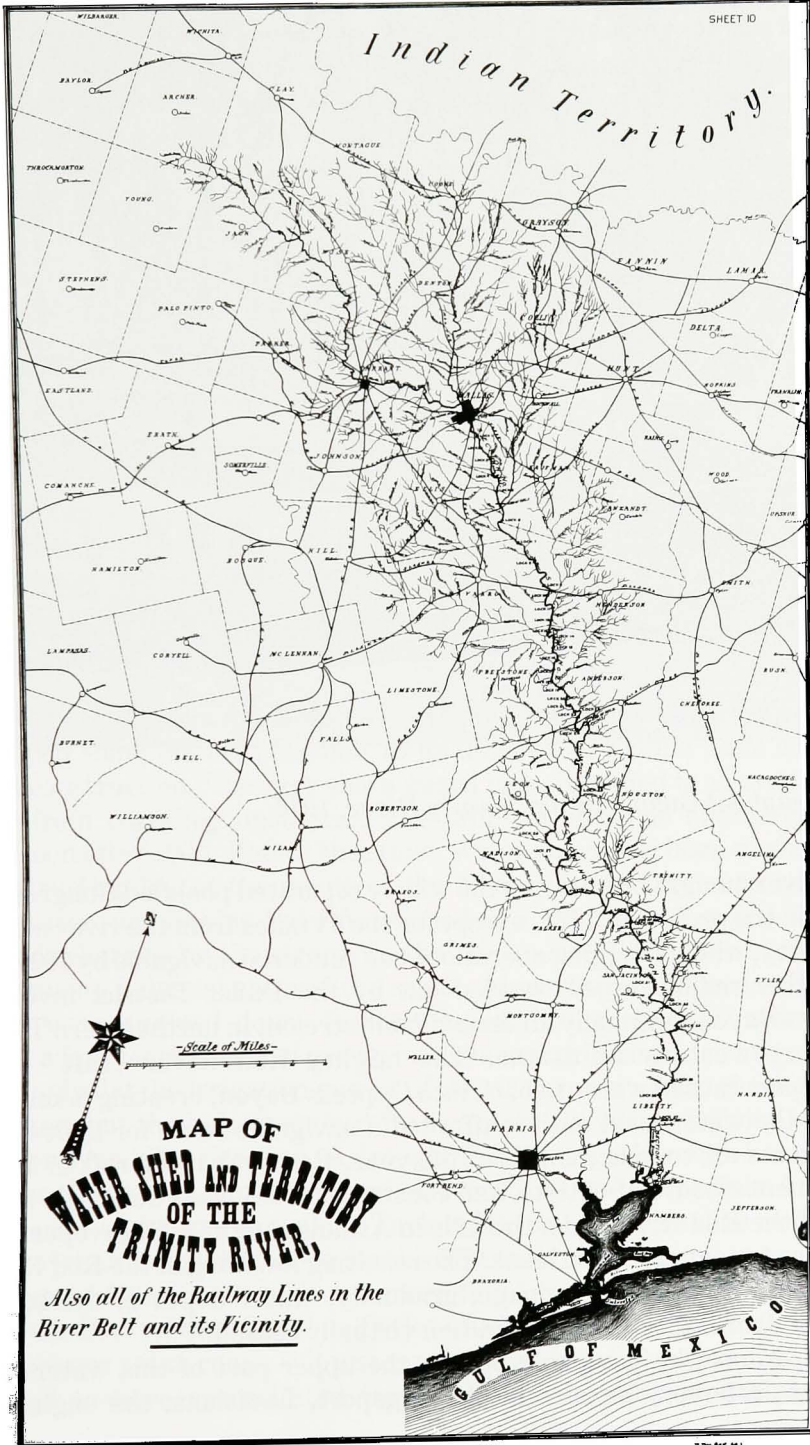
Measured by the yardstick of far-reaching results, conversion of the Sabine-Neches Waterway might well be considered the most significant accomplishment of the Dallas District. During its fourteen-year existence, however, this district tackled other ambitious assignments.

One project, adopted in 1902, sought to improve the Trinity River. Formerly, rafting of logs had constituted the only commerce above Liberty, located 41 miles above the mouth of the 760-mile river. Behind the proposed improvement lay hopes of inland planters to gain a water route along which they could move their cotton to Galveston. With the objective of a 6-foot-deep canal extending 511 miles from the river's mouth in Galveston Bay upstream to Dallas, this project called for open-channel work and a system of locks and dams. Initially, thirty-seven locks, with chambers 140 feet long and 50 feet wide, were contemplated; however, by 1918, only nine locks and dams had been covered by specific appropriations.⁴⁵

Work on the first lock and dam began after passage of the rivers and harbors act in 1905 and was completed in 1909, when the army engineers received operation and maintenance responsibility for this and subsequent locks and dams. By 1917, an auxiliary dam had been constructed at Parsons Slough, 22 miles below Dallas, and seven locks and dams had been completed. A contribution of \$50,000 from local interests was not forthcoming and the last two of the nine authorized locks and dams were never constructed. Meanwhile the engineers estimated another twenty-seven would be needed to completely canalize the river. Difficulty maintaining

Opposite page: Map of Trinity River, published with 1899 survey report, shows proposed locks and dams.

Indian Territory.





* *U.S. snagboat Guadalupe on Trinity River, 1910*

open-river navigation between the widely separated pools led Congress to abandon the project in 1922, except for the 41 miles from the river mouth to Liberty, which snagging operations had rendered navigable by 1917.⁴⁶

Another major project carried out by the Dallas District involved Cypress Bayou, originally an unnavigable stream, in northeastern Texas and northwestern Louisiana. The mighty Red River "raft" near Shreveport caused water to back into Cypress Bayou, creating lakes and raising the water level until it afforded a navigable route for light-draft steamboats six to nine months of the year. Removal of the raft in 1873, subsequent closure of outlets, and construction of levees down the right bank of the Red River from the hills in Arkansas to near Shreveport cut off the water supply to the lakes. The resulting lowering of the Red River bed prompted quicker drainage; gradually, water depth in the bayou decreased until 1897 when navigation virtually ceased.⁴⁷

To preserve the navigable pool in the upper part of this waterway, between Jefferson, Texas and Mooringsport, Louisiana, the engineers

proposed constructing a dam on Caddo Lake, 2 miles below Mooringsport. They estimated that without this protection, this portion of the bayou would be ruined by the declining water level that had already destroyed navigation on the lower portion of the waterway to Shreveport. The year 1906 showed signs of revived industrial activity in the area: new sawmills going up, older ones increasing their capacities, and large deposits of iron ore near Jefferson to be worked.⁴⁸

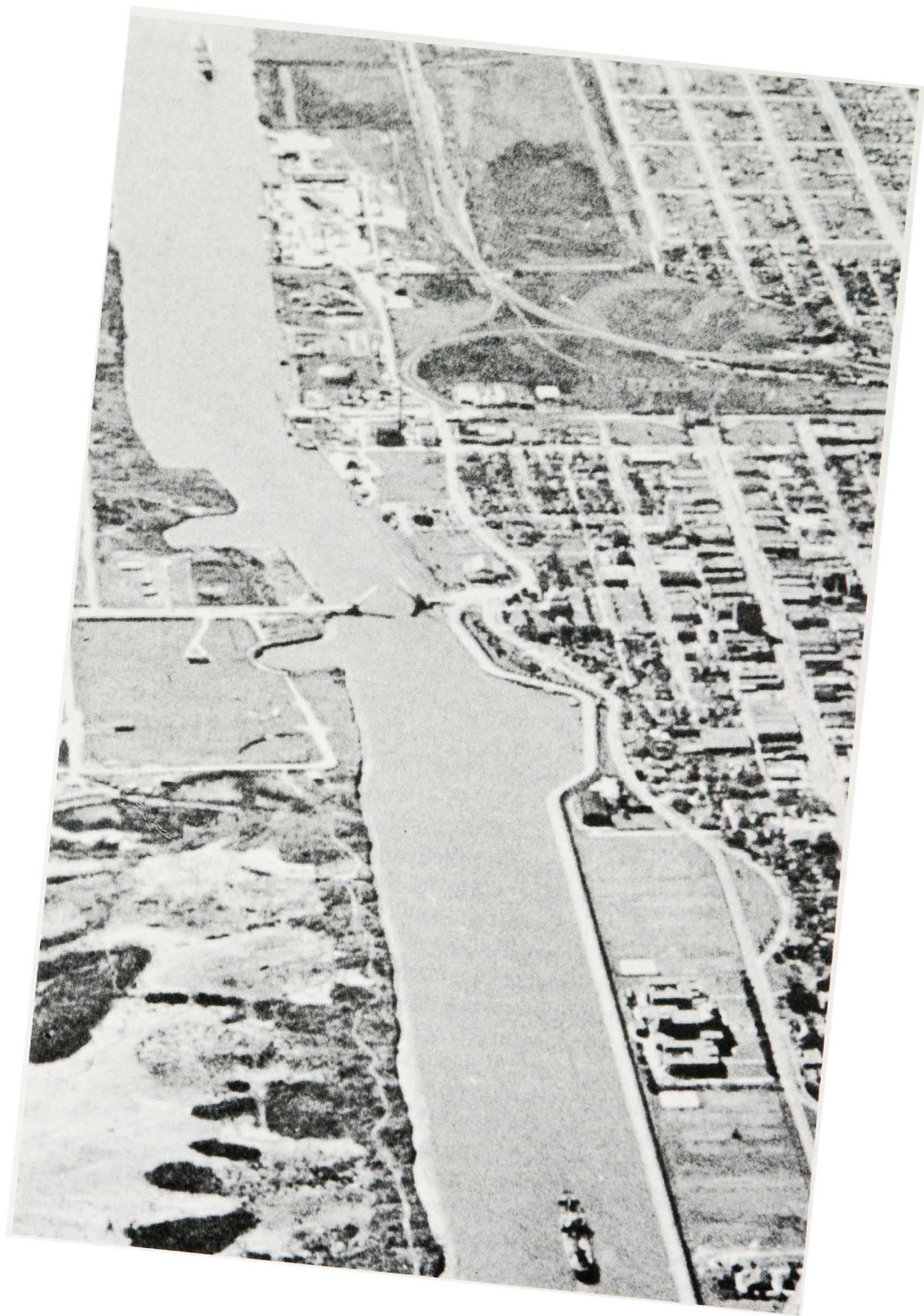
Congress authorized the Caddo Lake Dam in 1910. Supported by a pile foundation, the fixed dam extended 3,400 feet in length and assured a 4-foot depth for navigation. By the end of 1914, the Dallas District had completed and taken over operation of the \$100,553 structure.⁴⁹

At the time of its abolition, the Dallas District was bounded on the east by the Red River and the Sabine River, on the south by the Gulf of Mexico, on the west by the Brazos River, and on the north by the Red River plus two of its tributaries, the Kiamichi River in Oklahoma and the Little River in Arkansas.⁵⁰ In 1919, the Dallas District was dissolved and the bulk of its responsibilities assigned to the Galveston District.

Idiosyncrasies of the Inland Canal

Under these various engineer districts, the Sabine-Neches Waterway developed some features peculiar to its location on Sabine Lake and its inland construction. The first was a guard lock, intended to prevent salt water from traveling upstream. The problem of saline encroachment arose soon after 1900. Before that time, water usage had been moderate, an obstructing bar at the mouth of the Neches River served to contain fresh water, and Sabine Lake functioned as a natural reservoir of fresh water discharged by the rivers. In the mid-to-late 1890s, however, the rice-growing industry entered the scene. About three hundred carloads of rice were shipped down Taylors Bayou during the 1897 season.⁵¹ Within a few years, rice had grown into a booming business.

Not only did the irrigation pumps of the rice growers raise the demand for water, but they also required fresh water. Excessive salinity would injure or even kill a rice crop. A drought in 1901, together with increased drain on the freshwater supply and modifications due to the Port Arthur Canal, caused rice growers along Taylors Bayou to suffer saline contamination of their irrigation water for the first time. By 1902, planters along Taylors and Hillebrandt bayous were calling for a saltwater guard lock in either the Port Arthur Canal or Taylors Bayou. The same year, forecasting problems yet to come, salt water was noted above Beaumont and was reported to have necessitated temporary interruption of pumping at



plants located 7 and 10 miles above the mouth of the Neches River. Oil refineries, just beginning to appear along the waterway, added further demands for fresh water.⁵²

Although the 9-foot-deep Sabine-Neches barge canal did not facilitate appreciable movement of seawater into the Neches River, the anticipated effects of a 25-foot channel "turned the tide." The rice growers had become a powerful force to be reckoned with and they were not about to support waterway changes without assurance of adequate protection against saltwater encroachment. Accordingly, they attached a provision to the bond issue for the Beaumont Navigation District's \$428,000 contribution to the waterway and installation of a saltwater guard lock became a legal condition of Beaumont's local participation in the deep-water project. Constructed 6 miles above Port Arthur on the Sabine-Neches Canal, the guard lock was transferred to the Beaumont Navigation District for maintenance on June 1, 1916.⁵³

The lock hardly proved a navigational asset; on the contrary, it presented just one more problem in a narrow channel with steadily growing commercial usage. While it served to impede passage of salt water up the river, the lock did not absolutely prevent saline intrusion. By 1919, a 30-foot-channel project was in the offing and one consideration was a proposed two-way guard lock. In 1921, army engineers began conducting a comprehensive salinity survey. They concluded, late in 1923, that the original lock should be removed and that the federal government should place no new guard lock in the Sabine-Neches Waterway.⁵⁴

As an obstruction to navigation, the lock was doomed by legislation in 1925.⁵⁵ A bypass channel was constructed around it and removal was finally completed during the 1952-53 fiscal year. First of its kind in the district, the guard lock represented an early instance of the Corps's efforts to preserve ecological balance. Years later, the engineers would again direct their energies toward protecting Sabine Lake both from saltwater encroachment and other types of channel pollution.

The "inland" location of the Sabine-Neches Canal created another problem. Before completion of the 9-by-100-foot barge canal in 1908, the city of Port Arthur had fronted on Sabine Lake. The Port Arthur Pleasure Pier Company, a private concern, had installed amusement facilities on the outer end of a wooden pier extending about half a mile into the lake. During the years 1912 to 1914, the company expanded the pier and recreational facilities by constructing a concrete sheet pile enclosure filled with material dredged from Sabine Lake. Construction of the Sabine-Neches Canal had left a number of small tracts of land between the canal

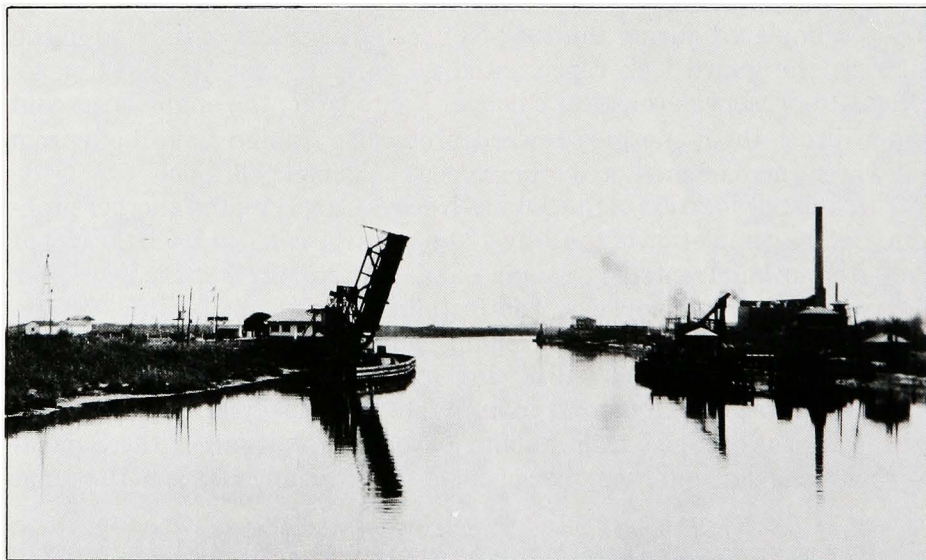
Opposite page: Port Arthur Canal, looking south, 1958

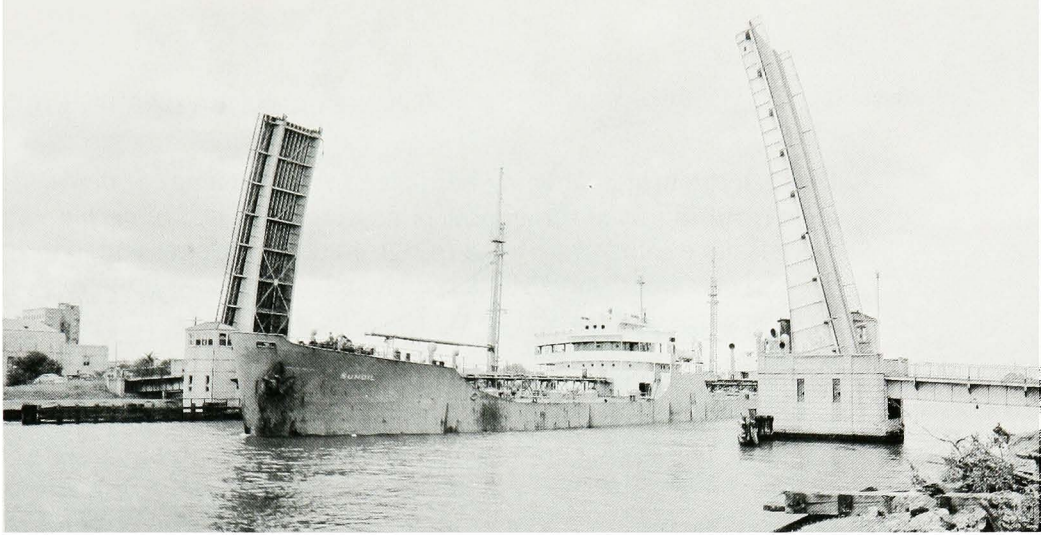
and the lake. This material dredged initially was augmented over the years, eventually resulting in a continuous bank between the canal and the lake that ranged in width from 500 to 2,000 feet. This strip of land was called "Pleasure Island."⁵⁶

To provide access from the city to Pleasure Island, the Pleasure Pier Company built a single-leaf bascule bridge. This structure afforded a 90-foot horizontal clearance across the canal, which meanwhile had been authorized for 25-foot depth. Although plans were approved by the acting secretary of war on September 30, 1912, when the district engineer reported completion of the bridge on April 11, 1914, he noted it to be 1½ feet lower than authorized. Dredged to deep-draft dimensions of 25 feet by 1916, the channel quickly outgrew the bridge, which was taken over by the city of Port Arthur in 1920. When the canal width was increased to 125 feet in 1922, the city added a second short bascule leaf to the east end of the bridge. Later modification of the canal in 1927 provided for a channel 30 feet deep and 150 feet wide. At this point, the bridge was in imminent danger of collapse and the city removed it in 1928.⁵⁷

A new double-leaf bascule bridge, completed by the city in 1931, provided horizontal clearance of 200 feet.⁵⁸ All vessels bound for points above Port Arthur were obliged to sail under this bridge. After 1934, barges traveling along the new Gulf Intracoastal Waterway between New Orleans and Galveston further swelled the traffic along this route. As larger

Old bascule bridge, looking south, on Port Arthur Canal, 1925. Port Arthur Field Office appears at left of bridge.





Double-leaf bascule bridge built in 1931 and later extended still made for a “tight squeeze” as larger tankers traveled the Port Arthur Canal.

vessels plied the waterway and the volume of commerce increased, the bridge presented a mounting hazard to navigation.

By 1946, four modifications of the waterway had enlarged the then 36-foot-deep Sabine-Neches Canal to a width of 400 feet, except through a 4,000-foot reach in the vicinity of the bridge. To alleviate the problem of strong tidal currents through this restricted reach, Congress authorized channel enlargement through this stretch to conform to the general project dimensions. Army engineers accomplished eastward extension of the bridge by removing the original 45-foot east approach span and building three new approach spans, each 100 feet long. Completed in 1953, this bridge reconstruction permitted channel dredging below to match canal dimensions overall. The dredging removed the site of the original area office constructed in 1909, necessitating construction of a new building, farther to the east. The 200-foot-wide navigation opening of the bridge was not affected, however, and the main pier supporting the east bascule leaf was situated approximately on the centerline of the 400-foot channel.⁵⁹

Contemplation of a 40-foot canal project depth in 1962 produced this description of the bridge's effect upon navigation:

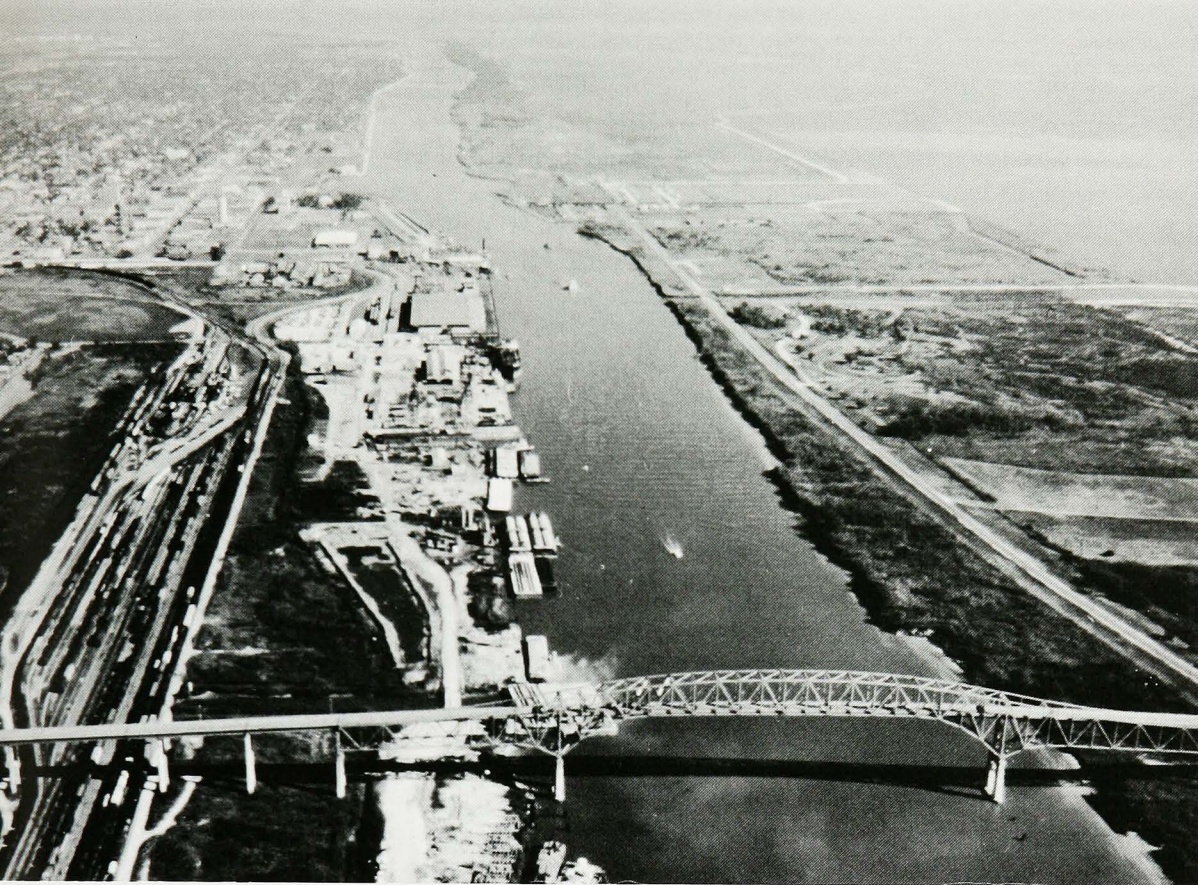
Vessel pilots and operators are very reluctant to attempt passing other vessels in the narrow bridge opening. Numerous short delays result from the stopping or slowing of one vessel to await passage through the bridge of another vessel. This practice frequently creates a hazardous condition because of the loss of steerageway by the waiting vessel. It has become virtually impossible to maintain an adequate fender system

through the bridge opening because of the frequency of damages resulting from the impact of passing vessels. Numerous vessels have collided with the bridge structure proper and, on several occasions, have rendered the movable spans inoperative for periods of several days.⁶⁰

Periods when the bridge was out of service, which on one occasion actually ran into months, not only inconvenienced Port Arthur Area Office personnel who were forced to rely upon boat transportation to and from work; the bridge had also become part of a vehicular route into Louisiana with construction of the Sabine Lake Bridge and Causeway in the early 1950s. Crossing the bridge from Port Arthur to Pleasure Island, running southward down a county road along the canal for about 9 miles, and then traversing the new Sabine Lake Bridge into Cameron Parish, Louisiana, this route offered the only alternative for Corps personnel when water transportation was not accessible. More than once, area office employees had to drive this way into Louisiana, up to Sulphur, back into Texas through Orange, and down to Port Arthur, a distance of 120 miles to get from office to home. Finally, the bascule bridge's location, about two blocks from the business district of Port Arthur, and the large number of tankers carrying volatile petroleum cargoes threatened the heart of the city with the potential for an explosive collision.⁶¹

A replacement bridge, authorized as part of a 40-foot project for the waterway's inland channels, was to be located about a mile downstream. The old bascule bridge was demolished and removed over a 10-month period ending late in May, 1969, at a cost of \$456,000. Construction on the \$8.8 million, fixed-span, high-level bridge began in 1967 and was completed in 1970. Extending 5,032 feet from abutment to abutment, the structure provided 400-foot horizontal clearance in the channel under a 664-foot center span with 138-foot vertical clearance. Including the approach ramps brought the overall length to 7,698 feet. The new Gulfgate Bridge at Port Arthur won the Award of Merit from the American Institute of Steel Construction in the 1971 Prize Bridge National Competition.⁶²

Another persistent problem was the tendency for material dredged from the landlocked portion of the canal and deposited on Pleasure Island to erode and wash into Sabine Lake. In 1935, modification of the waterway project provided for works to protect the lake against such pollution. Several years later, a 9,350-foot-long pile retaining wall was constructed; however, the area it afforded was soon filled and later developed. Maintenance dredging and periodic channel enlargements continually produced large amounts of material for which new disposal sites were needed.⁶³



Northward view of Port Arthur Canal shows new Gulfgate Bridge in foreground (downstream from site of previous bascule bridge) and North Disposal Area in right background.

Eventually, the city of Port Arthur and other recreational interests objected strenuously to further unconfined depositing of dredged matter on the man-made strip of island fronting the lake. Those opposing this practice alleged damage to the sport fishing and recreational potential of Sabine Lake. Consequently, for a time after 1958, the engineers discontinued using Sabine Lake for disposal purposes. Most dumping was done on undeveloped land banks west of the canal. Where this was not possible, such as at Port Arthur, dredged material had to be hauled by hopper dredge to points above or below the city and rehandled by pipeline dredge into dumping areas.⁶⁴

Adoption in 1962 of the 40-foot project for the Sabine-Neches Waterway brought the problem sharply into focus. By 1965, the last of the undeveloped areas along the land side of the channel, between the head of the Port Arthur Canal and a point 2 miles below the mouth of the Neches River, had been lost to industrial and residential development.

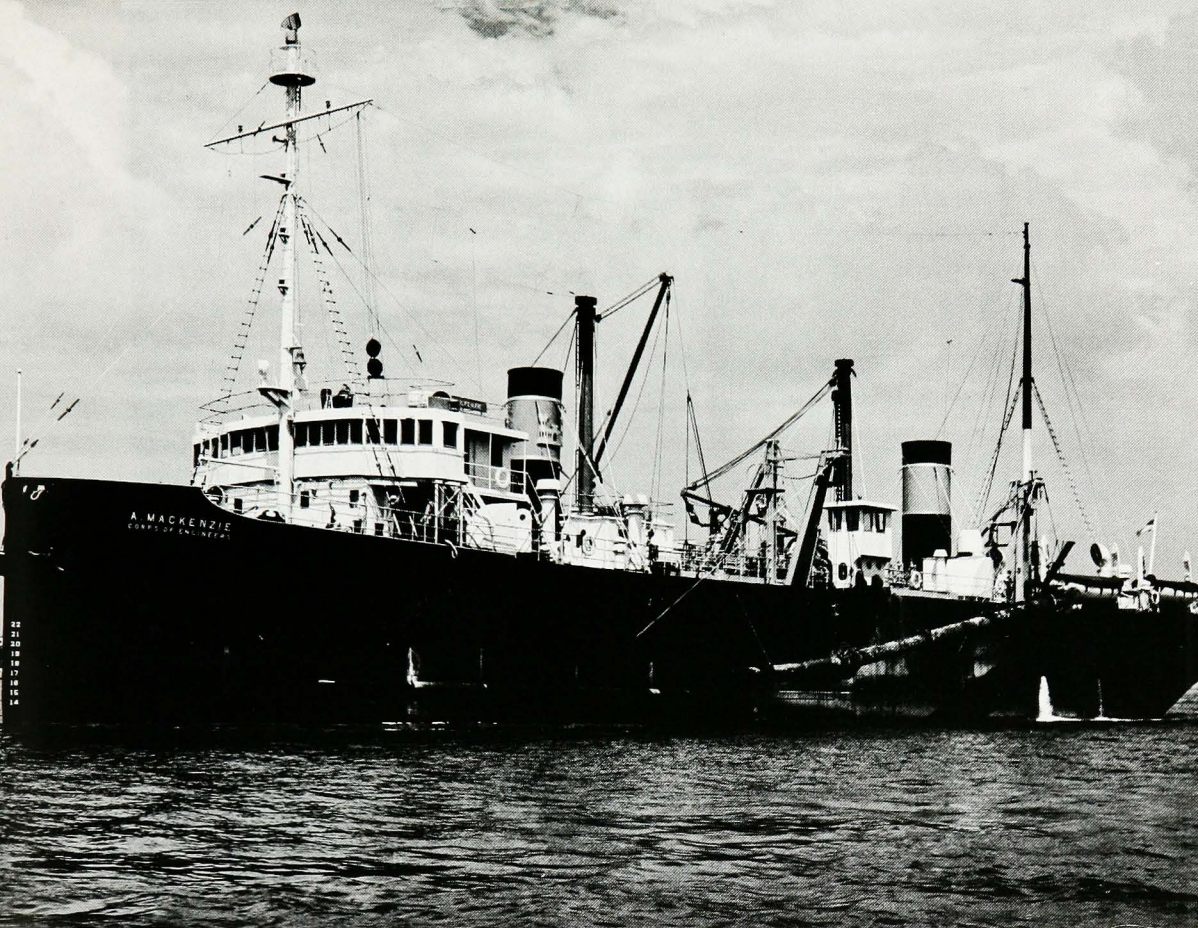
Dredging in this 10½-mile reach would involve discharge lines more than 5 miles long. Use of hopper dredges here was also undesirable, both because of their shortage and the hazards of operating such vessels in a narrow channel supporting heavy traffic.⁶⁵

A solution was found by creating two new disposal areas in Sabine Lake, one above and one below Port Arthur. To accommodate dumping needs, projected over a fifty-year period, earthen levees were built into Sabine Lake. Blanket stone covered by riprap protected their outer slopes from erosion. Spillways between interior and exterior levees at either end directed runoff back into the canal. The areas were designed to be built up to a 14-foot elevation. Port Arthur and Beaumont navigation districts participated in the cost to the extent of savings they would realize by being spared construction of retaining dikes, bulkheads, and other embankments at the land areas that would otherwise have been required.⁶⁶

The South Disposal Area, completed May 30, 1969, extended 30,700 linear feet (5.8 miles) along the lakefront, encompassing 3,580 acres. The North Disposal Area, completed September 16, 1969, extended 25,440 feet (4.8 miles) and encompassed 2,220 acres. Twenty-foot-wide, two-lane limestone roadways running along levee crowns were completed in 1974. By constructing these areas, the Corps of Engineers checked the troublesome problem of erosion causing pollution in Sabine Lake, preserved fishing and recreational interests of the vicinity, and provided sites for disposal to serve the Sabine-Neches Canal for the next fifty years.

One other interesting ramification of the 40-foot project involved a 72-mile dredging operation of unprecedented magnitude for the Galveston District. From 1965 until the project's completion in 1972, some 60 million cubic yards of material were dredged from the waterway. Under the previous 36-foot project, the outer bar channel had extended into the Gulf 3½ miles from the ends of the jetties. The new project necessitated dredging an additional 77,734 feet, almost 15 miles, from the end of the old outer bar channel, across an obstructive reef called Sabine Bank, and on out to the 42-foot contour. Half the project's total dredging was conducted in the 21-mile stretch from shoreline out into the Gulf.

Two government hopper dredges accomplished most of this offshore work. From 1967 to 1974, Galveston District claimed the distinction of operating the oldest and the newest in the Corps's dredging fleet. The oldest, launched in 1924, was named for Maj. Gen. Alexander Mackenzie, chief of engineers from 1904 to 1908. The *Mackenzie* entered war service in August, 1943, when she strapped on two 20-mm. antiaircraft guns and steamed out of San Francisco for Midway Island. There the dredge went to work widening the harbor entrance channel. Among the coral islands



U.S. hopper dredge A. Mackenzie

of the South Pacific, she suffered ravages of enemy attacks and violent typhoons. The *Mackenzie* returned to San Francisco, under tow, early in 1946, patched, battered, and worn. With surplus parts from destroyer escorts, she was overhauled in 1949 and put to work on the Pacific Coast.

The Galveston District intercepted the *Mackenzie* on her way to oblivion. Late in 1951, the dredge was en route to Philadelphia to be scrapped. The Galveston District, dredgeless at that time, managed to obtain the *Mackenzie* temporarily. Utilizing shipyard facilities then available at Fort Point, Galveston personnel gradually revamped the *Mackenzie*, replacing badly worn hopper beams and installing twin rudders to improve her somewhat wanting steering capacity. Eventually, the "old war horse" became attached to the district, where she functioned with outstanding economy for more than twenty additional years. Her riveted, black-painted hull became a familiar sight along the Texas Coast.⁶⁷

On March 6, 1974, the *Mackenzie* celebrated her fiftieth year. Barely a month later, on April 24, a tragic three-way collision, involving a foreign tanker and a smaller research vessel, sent the dredge, busy at work in the



The Mackenzie, several hours after fatal collision, April 24, 1974

Galveston Entrance Channel, to the bottom of the channel. Ironically, the dredge, which was struck as the other two vessels tried to avoid hitting each other, was the only one to sustain fatal injury, sinking within a matter of minutes. Although most of her sixty hands were aboard at the time, all managed to escape. The demise of the durable old ship presented a sad epilogue to her long history of productive service.

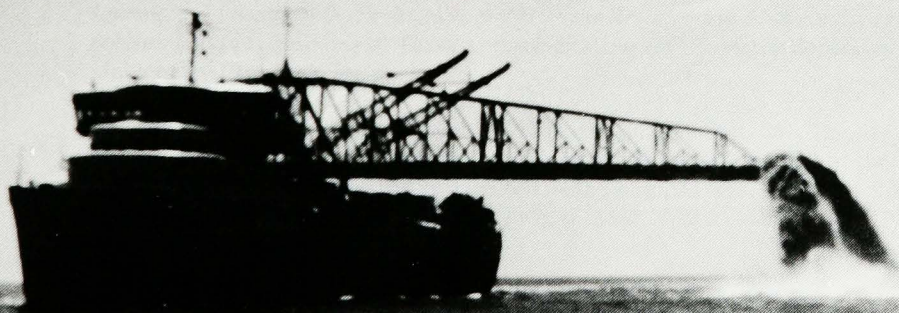
Newest dredge in the Corps's flotilla, the \$17 million *McFarland* had worked alongside the *Mackenzie* since April, 1967. Designed with flexibility to accommodate the idiosyncrasies of Sabine Bank Channel, the *McFarland* came equipped with a variety of unique features. Predominant among these ranked her versatility. This single-hopper dredge offered three alternate systems for disposal of dredged material. The traditional method of filling the hopper, hauling the material to a dumping site, and discharging it through gates in the bottom of the hull lent itself to handling the sand and shell reef at Sabine Bank. Closer in toward shore, where the muddy bottom is composed of fine silt carried down by the rivers, the dredge pumped this lighter material directly through a 222-foot-long side-casting boom, removing it from the channel and allowing it to be carried off by the natural currents. A third option, suited to

“beach nourishment” and certain channel conditions, allowed the dredge to connect with a pipeline through which material could be pumped to onshore disposal areas. Many other technical refinements, excellent maneuverability, and sophisticated control devices make the 300-foot-long, 72-foot-wide *McFarland* the most modern hopper dredge in operation by the Corps of Engineers.⁶⁸

On the evening of March 6, 1969, the *McFarland* was unexpectedly pressed into service of a non-dredging nature. As the dredge was working in the Gulf, the officer on watch spotted a shrimp boat that had caught fire about three-quarters of a mile away, just east of the Sabine-Neches Waterway outer bar channel. While contacting the U.S. Coast Guard at Sabine Pass, the dredge crew sped to the blazing shrimp boat. A launch was lowered overboard from the dredge to rescue the boat's two-man crew. Meanwhile, the fire spread rapidly, threatening to produce an explosion when it reached the several gasoline and butane tanks on board. Moving into action, the *McFarland* swung her discharge boom to the side and made five passes by the shrimp boat, pumping clear seawater to quench the fire. By the time the Coast Guard arrived, the fire was under control. Within three hours after sighting the burning vessel, the *McFarland* had returned to her routine duties, opening the waterway to world trade.⁶⁹

The Sabine-Neches Waterway has furnished the vehicle for the phenomenal growth that has characterized the southeastern corner of Texas. Vital commodities, from lumber, grain, and rice to oil and petrochemicals, have moved along its channels and tremendous economic development has flourished along its banks. Through their supporting role of improving and maintaining this essential waterway, Galveston army engineers have

U.S. hopper dredge McFarland sidecasting in Gulf of Mexico



contributed substantially to emergence of the thriving Golden Triangle (the industrial complex comprising Beaumont, Orange, and Port Arthur).

Port Arthur acknowledged this contribution by paying tribute to an outstanding civilian employee of the Galveston District. Doris L. Turpin spent more than forty years working in the Port Arthur area. When he retired from his position as Port Arthur area engineer in 1972, the city set aside a day in his honor. "Doris Day" served as a gratifying reminder that indeed the district *is* the men and women who conduct its day-to-day operations.

Notes to Chapter 3

¹ Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), p. 13.

² H.R. Ex. Doc. 365, 25th Cong., 2d sess. (1838), p. 2.

³ *Ibid.*

⁴ Texas v. Louisiana, 410 US 704 (1973); Louis J. Wortham, *A History of Texas*, 5 vols. (Fort Worth: Wortham-Molyneaux Co., 1924), 1: 377-78.

⁵ S. Doc. 199, 27th Cong., 2d sess. (1842), p. 4.

⁶ *Ibid.*, pp. 7-8, 14, 25, 74.

⁷ *Houston Post*, 23 June 1974; Texas v. Louisiana, 410 US 705-07 (1973).

⁸ Texas v. Louisiana, 410 US 702 (1973).

⁹ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 552-59.

¹⁰ *Ibid.*, pp. 558-59.

¹¹ *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1873* (Washington, D.C.: Government Printing Office, 1873), p. 684 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report); *ARCE*, 1875, pp. 947-48; H.R. Ex. Doc. 147, 47th Cong., 1st sess. (1882), pp. 3-4.

¹² *ARCE*, 1881, pp. 1322, 1324-25; Adjutant General's Office, Special Order 120, 26 May 1881; Captain Davis had charge of these improvements from 13 June to 23 October 1881.

¹³ Capt. Davis to Brig. Gen. H. G. Wright, Chief of Engineers, 24 June 1881, Galveston District Installation Historical Files (GDIHF).

¹⁴ Davis to Wright, 2 August 1881, GDIHF.

¹⁵ *ARCE*, 1882, p. 195.

¹⁶ H.R. Ex. Doc. 147, 47th Cong., 1st sess. (1882), pp. 7, 12-13; *ARCE*, 1920, p. 1101; *ARCE*, 1929, p. 952.

¹⁷ H.R. Ex. Doc. 147, 47th Cong., 1st sess. (1882), p. 8.

¹⁸ *ARCE*, 1896, p. 1514.

¹⁹ *Ibid.*

²⁰ H.R. Doc. 549, 55th Cong., 2d sess. (1898), p. 14.

²¹ *Ibid.*, p. 15.

²² *Ibid.*, pp. 14-15.

²³ *Ibid.*, pp. 15-16.

²⁴ *Ibid.*, p. 11; Rivers and Harbors Act of September 19, 1890, ch. 907, 26 Stat. 426; Rivers and Harbors Act of July 13, 1892, ch. 158, 27 Stat. 88.

²⁵ H.R. Doc. 549, 55th Cong., 2d sess. (1898), pp. 10-11.

²⁶ *Ibid.*, pp. 9-13.

²⁷ *Ibid.*, pp. 10-11, 41.

²⁸ H.R. Doc. 975, 66th Cong., 3d sess. (1920), p. 17; Rivers and Harbors Act of March 3, 1899, 33 U.S.C. §§ 401-418 (1970).

²⁹ Paul R. McGuff and Wayne Roberson, *Lower Sabine and Neches Rivers, Texas and Louisiana: A Study of the Prehistoric and Historic Resources in Areas under Investigation for Navigation Improvement*, Texas Archeological Survey, Research Report no. 46 (Austin: University of Texas, 1974), pp. 34, 38.

³⁰ *Ibid.*, p. 39.

³¹ Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; The five-man Board of Engineers for Rivers and Harbors was established under section 3 of the Rivers and Harbors Act of June 13, 1902; H.R. Doc. 634, 58th Cong., 2d sess. (1904), pp. 2-3, 16.

³² Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117; *ARCE*, 1906, p. 1320.

³³ *ARCE*, 1908, pp. 476-77.

³⁴. Rivers and Harbors Act of March 2, 1907, ch. 2509, 34 Stat. 1073; H.R. Comm. Doc. 50, 61st Cong., 2d sess. (1909), pp. 2-3.

³⁵. In 1903, two recent graduates of the University of Texas, Nathaniel T. Blackburn and Richard B. Gillette, joined the Galveston District. When the Dallas District was formed, Gillette was assigned to carry the records to the new district. He remained with the Dallas District until its abolition, returning to Galveston where he completed more than forty years of service to the Corps. Blackburn stayed in Galveston, working for the district until the early 1930s. When he died in 1967, he left a bequest of over \$1 million to the National Audubon Society.

³⁶. *ARCE*, 1905, p. 399.

³⁷. *ARCE*, 1909, p. 1526.

³⁸. Capt. Heuer to Chief of Engineers, 31 October 1881, GDIHF.

³⁹. H.R. Doc. 773, 61st Cong., 2d sess. (1910), pp. 14, 17-18.

⁴⁰. H.R. Doc. 836, 61st Cong., 2d sess. (1910), p. 3; Rivers and Harbors Act of June 25, 1910, ch. 382, 36 Stat. 630.

⁴¹. H.R. Doc. 1290, 61st Cong., 3d sess. (1911), pp. 2-4.

⁴². *Ibid.*, p. 27.

⁴³. *Ibid.*, pp. 10, 12, 15, 19. Railroad rates regulated by the commission were based on the shortest distance from point of origin to deep water. The "differential," equivalent to the Direct Navigation Company's water rate between Houston and Galveston, applied to goods moving by rail from Houston to deep water at Galveston as well as from Beaumont and Orange to the seaport at Port Arthur. For example, on 100 pounds of cotton, the differential amounted to an additional six cents over the fixed forty-five-cent rate to Houston, Beaumont, or Orange. Establishing deep-water ports at Beaumont and Orange (or for that matter any other inland port to which seagoing vessels could proceed without breaking cargo) would result in abolition of the differential and increased competition among Texas ports.

⁴⁴. Rivers and Harbors Act of February 27, 1911, ch. 166, 36 Stat. 933; Rivers and Harbors Act of July 25, 1912, ch. 253, 37 Stat. 201; H.R. Doc. 975, 66th Cong., 3d sess. (1920), pp. 16, 20.

⁴⁵. Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; H.R. Doc. 409, 56th Cong., 1st sess. (1900); *ARCE*, 1913, p. 824; *ARCE*, 1918, p. 1070.

⁴⁶. Rivers and Harbors Act of March 3, 1909, ch. 264, §6, 35 Stat. 815; *ARCE*, 1920, p. 1115; H.R. Doc. 989, 66th Cong., 3d sess. (1921), p. 27; *ARCE*, 1922, p. 1144.

⁴⁷. *ARCE*, 1918, p. 1083.

⁴⁸. H.R. Doc. 220, 60th Cong., 1st sess. (1907), pp. 4-5.

⁴⁹. Rivers and Harbors Act of June 25, 1910, ch. 382, 36 Stat. 630; *ARCE*, 1915, pp. 945, 947; The dam was built with the idea of later installing a lock should circumstances justify reopening navigation in the reach below the dam to Shreveport. Subsequent studies for such a lock, conducted in 1913, produced unfavorable reports, however, and the additional work was not undertaken. H.R. Doc. 236, 63d Cong., 1st sess. (1913), p. 6.

⁵⁰. *ARCE*, 1918, p. 1057.

⁵¹. H.R. Doc. 549, 55th Cong., 2d sess. (1898), p. 20.

⁵². *Interim Review of Reports on Neches River and Tributaries, Texas Covering Salt Water Barrier at Beaumont, Texas* (Galveston: U.S. Army Engineer District, 1973), p. C-10; H.R. Doc. 634, 58th Cong., 2d sess. (1904), pp. 8, 12.

⁵³. *Salt Water Barrier*, p. C-11; Dimensions of this first attempt to prevent saltwater intrusions were 80 feet in width, 646 feet in length between miter sills, and 28 feet in depth over the miter sills at mean low Gulf level. H.R. Doc. 975, 66th Cong., 3d sess. (1920), p. 5.

⁵⁴. H.R. Doc. 975, 66th Cong., 3d sess. (1920), p. 29; H.R. Doc. 234, 68th Cong., 1st sess. (1924), pp. 5, 24.

⁵⁵ Rivers and Harbors Act of March 3, 1925, ch. 467, 43 Stat. 1186.

⁵⁶ Disposition Form, Galveston District to Southwestern Division Engineer, 23 October 1961, "Request for Approval of Proposed Apportionment of Cost of Relocation of Pleasure Pier Bridge at Port Arthur, Texas," no. SWNGW-1a, GDIHF (hereafter cited as DF, "Pleasure Pier Bridge").

⁵⁷ H.R. Doc. 975, 66th Cong., 3d sess. (1920), pp. 45-46; DF, "Pleasure Pier Bridge."

⁵⁸ DF, "Pleasure Pier Bridge."

⁵⁹ Rivers and Harbors Act of May 17, 1950, ch. 188, 64 Stat. 163; DF, "Pleasure Pier Bridge."

⁶⁰ H.R. Doc. 553, 87th Cong., 2d sess. (1962), p. 50.

⁶¹ DF, "Pleasure Pier Bridge."

⁶² Rivers and Harbors Act of October 23, 1962, Pub. L. No. 87-874, 76 Stat. 1173; *ARCE*, 1969, p. 483; The bridge was designed by the consulting firm of Modjeski and Masters.

⁶³ Memo, Col. John E. Unverferth, Galveston District Engineer, to Southwestern Division Engineer, 2 March 1965, "Spoil Disposal — Sabine-Neches Waterway," GDIHF.

⁶⁴ *Ibid.*

⁶⁵ *Ibid.*

⁶⁶ *Ibid.*

⁶⁷ Capt. Kelly F. O'Neal served as master of the *Mackenzie* from 1952 to 1967. He assumed this command after an unusual tour of duty with another of Galveston District's veteran dredges. Plans called for the *Manhattan* to be taken out of storage in Philadelphia and given to Thailand. O'Neal and a number of the former crew members signed up to deliver their old dredge and train a Siamese crew to take over its operation, arriving in Bangkok late in June, 1951. The Thai government had planned elaborate ceremonies to receive the vessel. Buddhist priests blessed the *Manhattan* and officials boarded the flower-decked dredge, when the festivities were interrupted by a full-blown political revolution. After some harrowing experiences, O'Neal and his men spent four months in Thailand completing their mission before they returned safely home.

⁶⁸ The vessel commemorates Arthur McFarland, who directed design, construction, and maintenance of dredging plant in Galveston from 1927 to 1935 and completed his distinguished career in charge of nationwide dredging operations in the Office of the Chief of Engineers. Late in 1976, the *McFarland* was transferred to the Jacksonville District in exchange for the *Gerig*.

⁶⁹ *Galveston Daily News*, 21 March 1969.



Buffalo Bayou Bonanza

By the year 1907, Galveston had outstripped her chief Gulf Coast rival, New Orleans, ranking second among all U.S. ports in the value of foreign exports. Exporting goods valued at \$220,504,917 in 1911, the island port remained second only to New York. Cotton held fast as its predominant article of export.¹

But commercial dynamics along the Texas Coast were slated for drastic change and much of the groundwork for the metamorphosis had already been laid. As Galveston reveled in port prosperity, other Texas harbors were struggling to acquire deep water and gain ascendancy. The new port of Texas City had been established with relative speed. A 16-foot-deep channel from deep water in Galveston Harbor across Galveston Bay to Texas City first had been dredged by the Texas City Terminal Company during 1895-96. Taken over by the army engineers in 1899, the 7-mile-long channel was deepened to 25 feet by 1905; another ten years would see adoption of a 30-foot project. The Sabine-Neches Waterway was well underway and, further down the coast, other channels were being improved by the Galveston engineers. Fifty miles inland from Galveston, interests along Buffalo Bayou were pursuing their particular goal with dogged persistence.

A Pioneer Vision

The goal of a ship channel extending from the Gulf to the head of navigation on Buffalo Bayou predates the inception of the city of Houston in 1836 and the boisterous era of the Texas Republic. Although early colonization had proceeded slowly along the banks of Buffalo Bayou, the stream's potential as a navigational outlet for produce of the rich Brazos agricultural region was quickly recognized. Running in an east-west direction, the bayou afforded a wide and deep stretch from its junction with the San Jacinto River to Brays Bayou, where the city of Harrisburg was established in 1826. Although its course became more narrow and tortuous between Brays Bayou and White Oak Bayou, Buffalo Bayou remained deep along this western extremity. Beyond the bayou's eastern extremity

Opposite page: From Long Reach turning basin, Houston Ship Channel winds its way toward the waters of Galveston Bay.

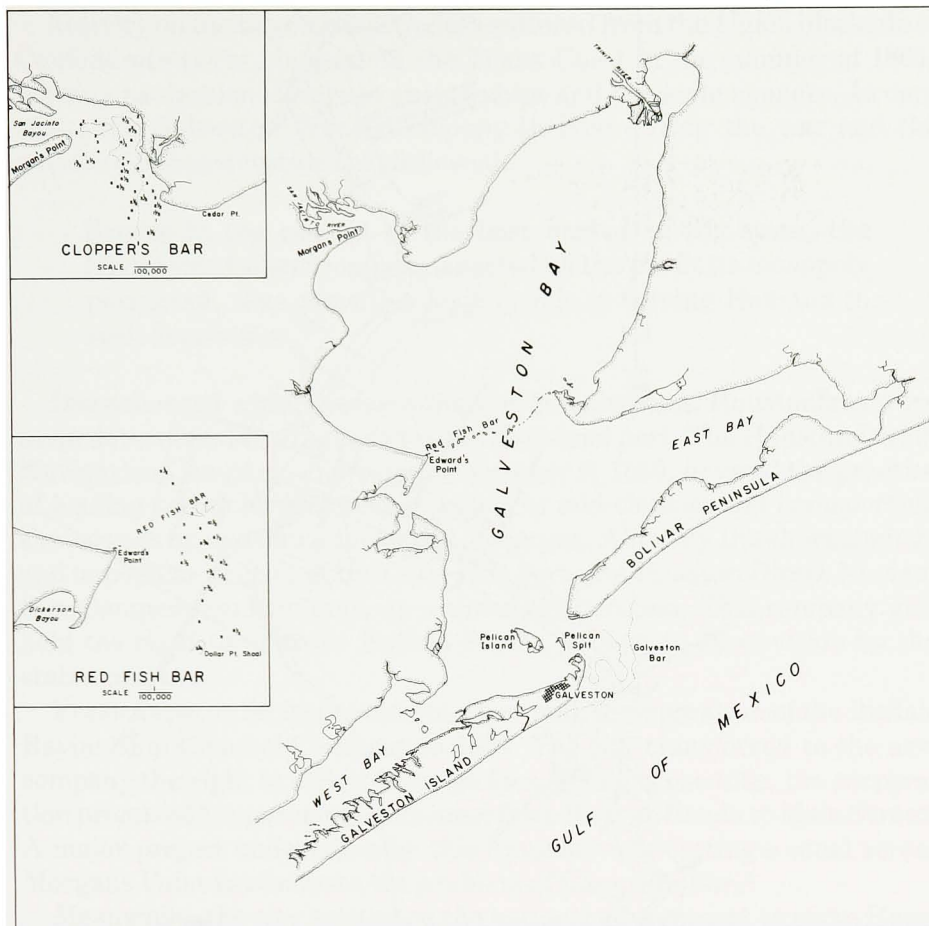
lay a direct path to the sea through the San Jacinto River, past Morgans Point, across the waters of Galveston Bay, and through Bolivar Roads and Galveston Channel.

Assorted impediments to navigation lay along the route that would grow into the Houston Ship Channel of the twentieth century. After crossing the 12-foot bar at the entrance to Galveston Channel, a vessel would next confront a shell reef, known as Red Fish Bar, which stretched across the middle of Galveston Bay. Running aground on this reef was an almost predictable occurrence in the course of a trip to Buffalo Bayou. Ship captains, at the mercy of the winds and tides, were resigned to waiting for the water level to rise before they could cross the bar and move on. The second obstruction of this type was Clopper's Bar, just opposite Morgans Point where the waters of the San Jacinto River entered Galveston Bay. Beyond this point, the meandering stream accommodated light-draft vessels fairly well as far as Harrisburg. The reach above Harrisburg required, at the least, removal of snags and logs to make its winding course navigable.

An ordinance passed by the Houston City Council on June 10, 1841, established the Port of Houston with authority over all wharves, landings, slips, and roads on the banks of Buffalo and White Oak bayous within the city limits. This provided not only the first semblance of order along the waterfront, but also for collection of wharfage fees that could be applied to waterfront and bayou improvement. Early the next year, the Texas Republic empowered the city of Houston to clear away wrecked steamers and to insure future navigability above Harrisburg by levying a tonnage tax on vessels entering Houston.²

By the early 1850s, wharfage revenue had enabled the city to clear the upper bayou of the troublesome snags and overhanging limbs, but in their place emerged a new hazard to navigation. Heavy rains washed mud from the city streets and from cuts in the embankments into the bayou, causing shoaling that necessitated acquisition of a dredge by the city around 1852. During this decade, the Houston Navigation Company (organized in 1851 as the Houston and Galveston Navigation Company) dominated navigation on the bayou. This company operated regular steamship service between Houston and Galveston, exercising a virtual monopoly on shipping.³

Efforts began to improve the obstructions further down the channel. Formerly, the states rather than the national government bore the burden of improving rivers, canals, and roads within their boundaries. Establishing a firmer financial footing, the new state of Texas was able to shoulder some responsibility for its streams. On February 7, 1853, the state legislature allocated \$4,000 each to Buffalo Bayou and the San



Obstructions in Galveston Bay (Traced from U.S. Coast Survey map dated 1851)

Jacinto River. In April, 1857, the state engineer awarded a \$22,725 contract for improving Clopper's Bar. Later followed a \$23,000 contract for improvement of Red Fish Bar.⁴

Of particular significance to bayou development was Houston's emergence, during the 1850s, as the railroad center of Texas. Houston was clearly victorious in its contest with Galveston for the land routes; however, when Galveston finally succeeded in obtaining its own railroad late in 1859, goods could be transported more cheaply between the two cities by rail than by bayou. Fighting to keep commerce on the bayou, Houston held a special election in May, 1860 and voters repealed the wharfage fees, no longer essential for bayou improvement.⁵

Activity on the bayou nevertheless suffered from the Union blockade of Confederate ports imposed on the Texas Coast in the summer of 1861, limiting navigation mainly to enemy ships and blockade runners. In contrast, the Galveston Wharf Company thrived during the war and the period of Reconstruction that followed.

Secure in the control of the best harbor in the state, the [Galveston] wharf company exacted all the profit its monopoly permitted, thus playing a leading role in driving Houston to seek deep water.⁶

Disenchanted with excessive charges at Galveston, Houstonians were more determined than ever to bypass the island port. The Houston Direct Navigation Company, chartered on October 9, 1866, devised the practice of loading and unloading ocean vessels in mid-channel and transporting the cargoes up and down the bayou on barges. Aided by the shortcomings and unpopular policies of the Galveston port, the Houston Direct Navigation Company quickly built up a thriving operation. This company also held the right to improve Buffalo Bayou, subject to supervision by the state engineer.⁷

Fresh impetus for improvement came with incorporation of the Buffalo Bayou Ship Channel Company in 1869. The city transferred to the new company the right to collect tonnage fees. Using these tolls, the corporation promised to open a 9-foot channel from Bolivar Roads to Main Street. A major project undertaken by this company was cutting a canal across Morgans Point to eliminate the problem of Clopper's Bar.⁸

Meanwhile, the city petitioned the national government to make Houston a port of entry. First presented in 1867, this request was granted on July 14, 1870. Barely a month earlier, on May 24, 1870, the state legislature had appealed to the United States to improve the bars along the Texas Coast.⁹

First Federal Survey

The rivers and harbors act of 1870 called for the first federal survey for a channel of navigation through Buffalo Bayou and Galveston Bay. Lt. H. M. Adams discharged this assignment between December 16, 1870 and January 6, 1871, with William D. Duke conducting the field work.

Opposite page: Photographic reduction of 1871 pen-and-ink drawing executed on linen, this portion of the original shows Buffalo Bayou from Main Street at left to a point beyond Sims Bayou at right.

Adams reported to Capt. C. W. Howell in New Orleans that he found the bayou at least 70 feet wide and navigable to Houston for vessels drawing less than 4 feet. He attributed the only obstruction to navigation to "the nature of the bayou itself between Harrisburgh [sic] and Houston." Besides being "narrow" and "circuitous," this stretch of the bayou was already experiencing growing pains from Houston's modest population of fifteen thousand inhabitants. This early urbanization, manifested in "clearing off and cultivation of the banks," accounted for shoaling where former depths of 15 or 20 feet had been reduced to but 3 or 4 feet by 1871.¹⁰

Below Harrisburg, Adams noted Clopper's Bar and Red Fish Bar as the only obstructions. The channels across these bars afforded barely 4 feet, in contrast to the average depth of 8½ feet through Galveston Bay.¹¹

Citing Houston's prominence as the railroad center of the state, Lieutenant Adams considered the advantages of improving the channel "obvious." While cotton, hides, and tallow comprised the principal exports, a sizable portion of the freight "of a miscellaneous character" that traveled up the bayou contained iron and other materials for the railroads being pushed forward from Houston. Adams recommended a 6-by-100-foot channel, justified on the grounds that it would create competition for the single railroad line from Houston into Galveston, diminish the cost of goods sent into the interior, facilitate the export of produce, and aid in the progress of railroad expansion.¹²

To dredge this channel through the bars, Adams estimated costs of \$10,560.50 for Red Fish Bar and \$52,244.50 for Clopper's Bar. He indicated the results would last only temporarily. Improvement of the 8 miles between Harrisburg and Houston would amount to considerably more — \$319,212 — and would involve not only snagging and dredging, but also preventing bank erosion by protecting the slopes with sheet piling.¹³

Transmitting Adams's report to the chief of engineers, Captain Howell questioned the propriety of making federal improvements on a channel from which a private company was collecting tolls. Adams had reported that the Buffalo Bayou Ship Channel Company was "making the revenue more secure" by cutting a canal at Morgans Point, through which deep-draft vessels would be obliged to pass in order to avoid Clopper's Bar. Howell advised that before the government begin any work on the channel, the company should relinquish its right to collect tolls on vessels proceeding up the bayou to Harrisburg and the government should reimburse the company for its expenditures on improvements below Harrisburg. Like so many of Howell's prophetic suggestions, this appears to have been disregarded at the time. On June 10, 1872, Congress appropriated \$10,000 for improvement of Red Fish Bar.¹⁴

Morgan's Controversial Cut

Events within the next few years brought the matter of the Morgans Point canal sharply into focus. A financial panic in 1873 halted the work of the Buffalo Bayou Ship Channel Company. Fortuitously, the following year, the Galveston Wharf Company withdrew from Commodore Charles Morgan the free use of its facilities, a concession his shipping line had enjoyed since 1867. This mighty pioneer of Gulf Coast shipping had just finished moving his steamship line headquarters from New Orleans to Brashear City (renamed Morgan City) in Louisiana where, by May of 1872, he had dredged a seaway from the Atchafalaya River to the Gulf; in 1874, he had not only dredging experience, but also idle dredging equipment.¹⁵

With his privileges at Galveston terminated, Morgan cast his shrewd eye up to Buffalo Bayou where he saw opportunity in the railroad boom. Thus Morgan was receptive to an appeal by the hard-pressed Buffalo Bayou Ship Channel Company to take over its operation. On July 1, 1874, Morgan agreed to construct a channel 9 by 120 feet from Galveston Bay to Houston for \$806,500 of the company's unissued capital stock and put his dredges to work under the supervision of Capt. John J. Atkinson. Having acquired control of the Buffalo Bayou company, Morgan also picked up controlling interest in the Houston Direct Navigation Company and the Texas Transportation Company, which provided in its charter for construction of a railroad from the vicinity of Brays Bayou to trunk line connections in Houston.¹⁶

While the army engineers were dredging a channel through Red Fish Bar and deepening the route across Galveston Bay, Morgan continued construction of the canal across Morgans Point and began developing terminal facilities at a spot where Sims Bayou joined Buffalo Bayou. The completed complex, including railroad, 1,100 feet of wharves, and a 250-foot-wide turning basin, was named Clinton after Morgan's birthplace in Connecticut. By April of 1876, Morgan's canal had been dug and the Morgan Line steamship, *Clinton*, drawing 9½ feet of water, navigated the new ship channel across the bay and up to Clinton, where goods could be loaded onto trains and continue the 6 miles up to Houston, center of the railroad network. The 6,100-foot channel dredged by the army engineers at that time was 14½ feet deep at mean low tide and connected respective depths of 9 feet and 8½ feet in the upper and lower bays. Already, most interests along the bayou were calling for a 12-foot channel that would eliminate the need for lightering in Bolivar Channel.¹⁷

After the opening of Morgan's canal and the *Clinton's* arrival at Sims Bayou, traffic picked up and the channel bustled with ships of the Morgan

Line and business of the Houston Direct Navigation Company. Taking a greater interest in the channel, Congress asked the engineers to recommend a route across Galveston Bay; in the spring of 1877, J. A. Hayward surveyed the upper bay and H. C. Ripley, the lower. The board of engineers convened in September of that year favored the direct route from the head of Bolivar Channel to Red Fish Bar.¹⁸ Subsequent appropriations were more generous and soon the engineers had contractors at work on a 12-by-100-foot channel.

Hayward did note in his report that vessels drawing more than 5 feet were obliged to travel through Morgan's canal, paying a fee of ten cents per ton. For deeper-draft vessels, Hayward did not know the rates, but he quoted the *Galveston Daily News* of February 16, 1877, which reported channel fees totaling \$105.26 levied on the schooner *George Sealy* in October of the preceding year. Bay improvements made by the army engineers permitted navigation up to the private canal, beyond which Morgan's Buffalo Bayou Ship Channel Company collected tolls. This practice of charging for passage through the canal was clearly growing into a larger problem. Morgan not only held to his right, but went a step further and stretched a heavy chain across the canal to assure that no vessels slipped through without paying.¹⁹

After the commodore's death in 1878, the Morgan interests proposed turning over their improvements to the federal government. A provision in the rivers and harbors act of 1879 acknowledged congressional acceptance of the proposal. The actual transfer took place only after completion of the government channel up to Morgan's cut in 1889, evaluation of his improvements by a commission of army engineers late in 1890, and mounting indignation and appeals to Washington. The odious chain was finally removed on May 2, 1892, when the U.S. paid \$92,316.85 for the 5½-mile-long canal.²⁰

Morgan had viewed his operation at Clinton as a stopgap measure pending completion of his railroad between Houston and New Orleans. Adhering to this long-range policy, his heirs opened the railroad in 1880, thereby diverting traffic from the ship channel.²¹ Maj. S. M. Mansfield took note of the departure of the Morgan traffic, reporting in 1883 that "conditions have very materially changed" since the 12-foot channel project was adopted in 1876. He correctly predicted that

. . . completion of the railroad through from Houston to New Orleans and changes in the railroad system of Texas are about to result in the abandonment of Clinton as a transfer point.²²

Among the other changed conditions that were to adversely affect immediate development of the ship channel were the gradually increasing depth over the bar at Galveston, nonuse of the cut that had been made through the lower bay, and lack of permanence from the dredging improvements that had been undertaken. All these were cited by Mansfield, accounting for his "not being able to bring myself to the point of *recommending an expenditure . . . in dredging* in this open bay."²³ Appropriations for the Galveston Bay Ship Channel were suspended from 1883 to 1888.

The Buffalo Bayou Project

At the other end of the line, the Houston Cotton Exchange took the lead in calling for improvements on the bayou. Congress responded on June 14, 1880, by ordering an examination of Buffalo Bayou from Sims Bayou at Clinton to the mouth of White Oak Bayou at Houston. Assistant Engineer R. B. Talfor conducted this examination, which resulted the following year in adoption of a project to clear and enlarge that portion of the bayou to channel dimensions of 12 by 100 feet. Overhanging oak, cottonwood, pine, and magnolia trees, roughly seven hundred to the mile, would have to be removed along 11 miles of the bayou. Talfor figured the necessary snagging, dredging, and sheet pile revetments where the banks tended to cave in would cost \$385,299.50, or \$66,000 more than Adams had estimated ten years earlier. This Buffalo Bayou project was separate and distinct from the Galveston Bay Ship Channel project. First funded in 1881 with \$25,000, the Buffalo Bayou project received appropriations every two years from 1882 to 1896, amounting to \$228,750 altogether. The project in Galveston Bay received a total of \$849,016.85 from its adoption in 1872 until 1896.²⁴

Maj. A. M. Miller, the officer heading the Galveston Engineer Office, reported in 1896 on the status of the Buffalo Bayou project. While the channel had been periodically cleared and deepened, the improvements failed to endure. Adding to chronic problems of surface wash from the banks and a fresh crop of snags and logs following each heavy rain, Houstonians were using the bayou as a dumping ground for the city's sewage, much to the detriment of both health and navigation. At the time of Miller's report, the channel had been recently cleared and deepened to 10 feet.²⁵

Viewing Buffalo Bayou as "one link in a waterway designed to connect Houston with Galveston and the Gulf of Mexico," Major Miller pointed out the wisdom of coordinating the improvements on Buffalo Bayou with

those in Galveston Bay, rather than handling them under separate appropriations as had been the practice:

In Buffalo Bayou the depth is generally less than that in Galveston Bay, consequently vessels that could otherwise reach Houston are prevented from going there.

To remedy this it would seem to be more beneficial if both works were consolidated into one, so that whatever appropriations were made might be expended at such points in the entire distance to Houston as would enable a channel of a uniform width and depth to be maintained.²⁶

Miller also recommended beginning the improved ship channel at the head of Long Reach, a point on the bayou about 6½ miles below Main Street, to "obviate the maintenance of a very narrow, tortuous, and shoal channel into the heart of Houston."²⁷

Determination for Deep Water

The dramatic deepening of the bar at Galveston, from 14 feet in 1893 to 25 feet in 1897, jeopardized the future of the Houston port activity. If oceangoing vessels could cross the bar and unload their cargoes at the Galveston wharves, the Houston barge trade would be doomed to obsolescence. Consequently, farsighted Houstonians began a deep-water movement of their own in the late 1890s, calling for a 25-foot-deep channel.²⁸

Congressional action on February 1, 1897 directed the secretary of war to make an examination and survey for a water channel of not less than 25 feet deep and 100 feet wide from the Galveston jetties up the existing ship channel and Buffalo Bayou to Houston, and for a harbor at or near Houston with minimum dimensions of 25 by 500 feet. For this purpose, a board of engineers, chaired by Col. Henry M. Robert and including Major Miller and Capt. George M. Derby, met at Houston on July 26, 1897. The survey had been made in April; on July 28, these three officers made a personal examination of the 58-mile route. To estimate the cost of the proposed improvement, they divided the channel into three segments, based on the difficulty of dredging and disposal involved in each. The first division, 25 miles through the open waters of Galveston Bay and Morgan's canal, could be easily dredged with no problems other than unfavorable weather for five cents per cubic yard. Recommending a width of 150 feet through this portion of the channel because of its tendency to deteriorate,

they figured the work could be done by hired labor and plant owned by the government for \$1.1 million. This would necessitate construction of two suction dredges costing \$100,000 each. In the lower bay, excavated material would be placed to the west of the channel so as not to interfere with the tidal basin. In the upper bay, the board recommended a dike be constructed east of the channel to contain the dredged material and protect the channel from the influx of sand and silt stirred up in heavy storms.²⁹

The second division, 24 miles between the north end of the Morgan canal and Harrisburg, while presenting no dredging difficulties, would require towing and dumping of the dredged matter. At a cost of fifteen cents per cubic yard, this division could be improved to dimensions of 25 by 100 feet for an estimated \$900,000.³⁰

The third division, 9 miles between Harrisburg and Houston, would require "removal of at least one bend by a cutoff and straightening and widening of others." About 2¼ miles below White Oak Bayou and just below the San Antonio and Aransas Pass Bridge, the board selected a point which they advised removing so that the 500-foot-wide turning basin could be located there. Work on this portion, owing to the greater disposal problems and correspondingly higher per unit cost of twenty cents per cubic yard, came to \$1.7 million. An additional \$300,000 for administration and contingencies brought the total estimate for the future Houston Ship Channel to \$4 million with an annual maintenance cost of \$100,000. The board considered this improvement justified by the "conservative estimate" of \$600,000 that would be saved in freight shipped through the Galveston entrance and along the proposed channel.³¹

Merged under the rivers and harbors act of 1899, the two projects became known as "Galveston Ship Channel and Buffalo Bayou, Tex." This act also accepted the report of the 1897 board of engineers and, as amended the following year, appropriated \$300,000 to the consolidated project, specifying that sums previously appropriated and available for either of the earlier projects and not necessary for administration, surveys, and maintenance be applied to improving division one, from the Galveston jetties through Morgan's cut. As of July 1, 1900, the balances remaining were \$36,210.52 from the Galveston Bay Ship Channel project and \$18,599.86 from the Buffalo Bayou project. With the limited funds available, work was begun constructing a pile and brush dike from Morgan's cut to Red Fish Bar late in 1900 and dredging a channel 17½ by 80 feet through the bay early the next year.³²

Capt. (later Col.) Charles S. Riché, the only officer to head the Galveston Engineer Office on three separate occasions, was then serving his second tour of duty in Galveston. Third highest graduate in the West Point class of 1886, Riché was first assigned to Galveston in September of

1897, shortly before the board of engineers reported on their examination for a 25-foot project. This sojourn was interrupted by the Spanish-American War. While he served with the First U.S. Volunteer Infantry in New Orleans, he was relieved in Galveston by the bewhiskered Col. James B. Quinn, who had served there under Howell in the 1870s. Riché returned to his duties with the Galveston Engineer Office in November, 1898 and remained there until May, 1903. During his final assignment in Galveston from 1912 to 1916, he would see the opening of the deep-water Houston Ship Channel. Reporting on this project in 1901, Riché noted that the excavation being performed by Charles Clarke & Co. of Galveston for 6.98 cents per cubic yard was being done at "one of the lowest contract prices ever obtained in the United States."³³

A devastating hurricane swept across Galveston in 1900, decimating the island and killing thousands of people. One of the country's worst natural disasters, this dire event added fuel to the simmering flame of Houston's ambitions, giving weight to the city's arguments in favor of a more protected port. Congress provided somewhat more generously in 1902 by appropriating \$1 million that could be applied to continuous work over the next few years. This permitted expanded operations, to dredge both divisions one and two to a uniform depth of 18½ feet and to widen the bay channel to 150 feet, begun under contract by the Bowers Southern Dredging Company of Galveston in 1903.³⁴

Two men joined the Galveston Engineer Office about this time, both of whom would achieve prominence in the years ahead. Capt. (later Lt. Gen.) Edgar Jadwin, who became district engineer in May, 1903, was one of the most outstanding officers to grace the Galveston roster. Graduating with the highest honors in his West Point class of 1890, Jadwin went on to distinguish himself on many fronts throughout his thirty-nine-year army career. During the Spanish-American War, he served with the Third U.S. Volunteer Engineers in Cuba, for a time commanding a battalion of his regiment at Matanzas, where he brought about many sanitary reforms. After his four years of service at Galveston, he was selected to assist General Goethals in construction of the Panama Canal. His accomplishments there included a ship channel through Gatun Lake and a breakwater at the canal's Atlantic terminus. As commanding officer of the Fifteenth U.S. Engineers Regiment during World War I, Jadwin was responsible for extensive construction operations, earning the Distinguished Service Medal and decorations from both the British and French governments.³⁵

On June 27, 1926, Jadwin was appointed chief of engineers. In this capacity, he sponsored the important Mississippi River flood-control plan which was adopted by Congress in March of 1929. His expertise and



The men who built the Houston Ship Channel, photographed at Morgans Point prior to 1915. Capt. Charles Crotty is seated at extreme left; C. M. Wood, third from left. Commodore E. M. Hartrick stands at extreme right. (Courtesy of Jack Beck)

astuteness were highly instrumental in securing passage of this controversial legislation. Jadwin retired from active service as a lieutenant general in August of 1929. The following year, President Hoover offered him the chairmanship of the newly created Federal Power Commission. He declined this appointment, serving instead as chairman of the Inter-oceanic Canal Board to determine whether the government should construct a canal across Nicaragua or increase the capacity of the Panama Canal. This assignment was cut short by his death in the Canal Zone on March 2, 1931.³⁶

Charles Crotty became a civilian employee of the United States Army Corps of Engineers on April 29, 1904. A veteran of the Spanish-American War, Crotty had served as a private under Jadwin in Cuba. Presenting himself at the Galveston Engineer Office's headquarters in the Trust Building at Twenty-third and Postoffice streets, Crotty began a forty-year career largely devoted to the future Houston Ship Channel.³⁷

His indoctrination was less than auspicious. Ushered into Captain Jadwin's office, he learned that the only position available was a temporary one as a surveyman with a field party that was completing a transit survey of Buffalo Bayou. He promptly accepted the two-month assignment, with compensation amounting to \$50 a month and board. From Commodore E. M. Hartrick, the principal assistant engineer, he received his instructions.³⁸

"Young man," said Hartrick, "you are going out to a malarial swamp where men do not last very long, but if you will get a quart bottle of good whiskey, put in it all the quinine it will absorb, and take a tablespoonful before each meal and two before going to bed, you will probably last the two months."³⁹

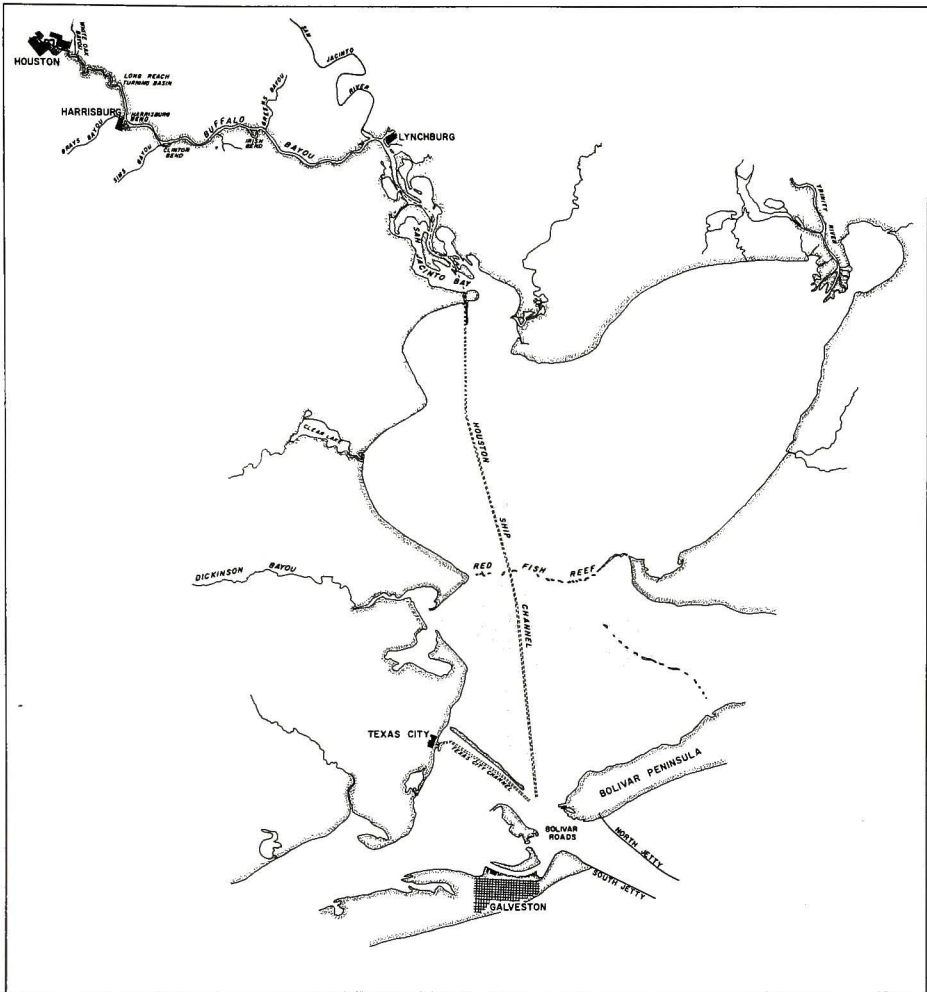
Crotty replied that he was a teetotaler and could not take the whiskey, adding that he had served in Cuba and the Philippines without suffering from malaria. Hartrick responded, "I don't care whether you take the whiskey or not, but take the quinine, or I'll not be responsible for your health."⁴⁰

Although he disregarded Hartrick's emphatic advice and used neither the quinine nor the whiskey, Charles Crotty survived his temporary assignment and secured permanent employment with the Galveston District. In April, 1920, he resigned his position with the army engineers to become assistant director of the Port of Houston, a post he held until his retirement in 1944.⁴¹

Captain Jadwin addressed himself to a new problem that was becoming evident about the time he assumed charge in Galveston. Ships were growing larger and modern vessels were approaching lengths of 300 to 350 feet. Already, vessels of 220 to 246 feet were encountering difficulties in navigating the sharper bends in the bayou, being obliged to reduce their speed to 2 miles per hour, and even then occasionally running into the banks. In August of 1904, Jadwin proposed two cutoffs — at Clinton Bend, a little below Sims Bayou, and at Irish Bend, just above Greens Bayou. He further advised that other bends be eased to a working radius of 2,500 feet.²

A recurring and controversial theme in the history of Buffalo Bayou centered on the location to be considered the proper head of navigation. Once again, this troublesome issue resurfaced, now a matter of where to terminate the deep-water improvement. The five-man Board of Engineers for Rivers and Harbors was requested by the House Committee on Rivers and Harbors to tackle this problem and to consider the project modifications proposed by Jadwin.⁴³

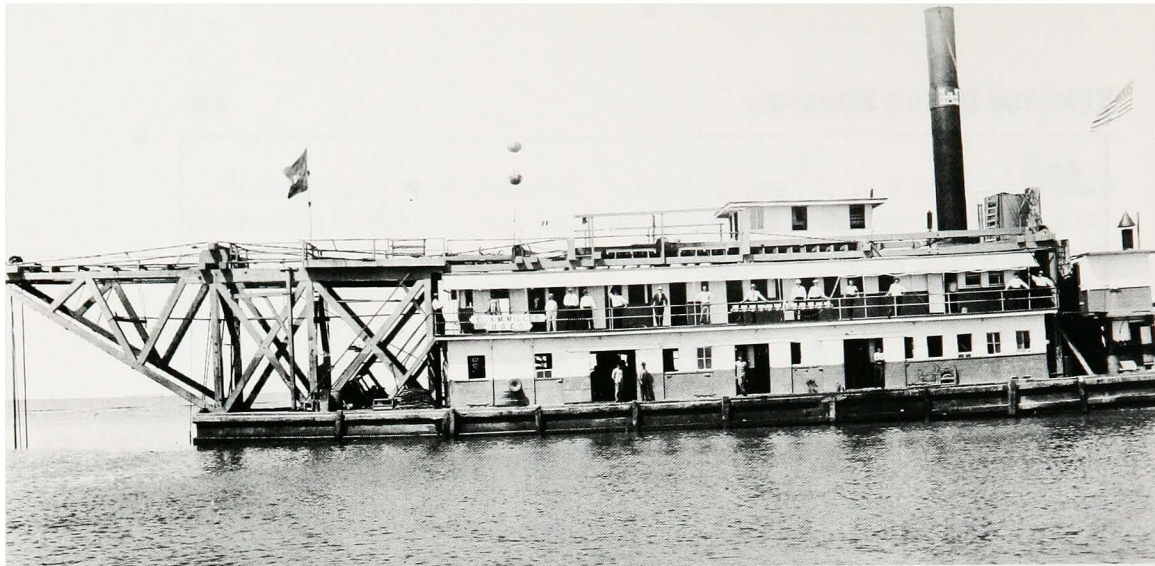
Although the question over the terminal point of the ship channel would persist up until, and occasionally beyond, 1926, when Houston extended its city limits to include Harrisburg, the board of engineers recommended in 1904 that the improvement be terminated and the turning basin be located at the head of Long Reach, 2 miles above Harrisburg. These officers modified dimensions of the turning basin to a 600-foot diameter and endorsed Jadwin's proposals for cutoffs at Irish Bend and Clinton Bend. They advised another cutoff at a point opposite Harrisburg, and easing of all other bends to a least radius of 2,500 feet. On March 3,



Houston Ship Channel, showing cutoffs at Harrisburg, Clinton, and Irish bends

1905, Congress appropriated \$200,000 for “continuing improvement to a point at or near the head of Long Reach,” as Jadwin and the board recommended.⁴⁴

Under contracts awarded to Bowers Southern Dredging Company, work began on Irish Bend and Clinton Bend cutoffs. During 1906-07, the Harrisburg cutoff was made by two U.S. dredges, the *Gen. H. M. Robert*, a small pipeline dredge, and the *Col. A. M. Miller*, a new 20-inch pipeline dredge. Charles Crotty helped plan the turning basin at Long Reach, which was dredged under contract between 1906 and 1908. At this time, the project depth was still only 18½ feet, appropriations were



U.S. cutter pipeline dredge Col. A. M. Miller was built in Galveston in 1906.

clearly inadequate for major strides to be made, and the Houston city fathers were once again impatient with the lack of progress.⁴⁵

Houston leaders joined Beaumont in securing legislation to provide for creation of navigation districts empowered to issue bonds. The bill passed by the Texas legislature in 1909 paved the way for not only Houston and Beaumont, but also for Orange, Corpus Christi, and other future Texas ports. Next, a Houston delegation met with the Rivers and Harbors Committee in December, 1909, setting a precedent by offering to share equally with the federal government the cost of a 25-foot channel. Armed with the favorable response of this committee, members of the delegation returned home to convince the Harris County electorate to support their plan. In January, 1911, the voters created the Harris County Houston Ship Channel Navigation District and passed a \$1,250,000 bond issue.⁴⁶

Houston Ship Channel

This renewed drive for deep water was reflected in the Rivers and Harbors Act of June 25, 1910, which changed the name of the project to the Houston Ship Channel and authorized \$2.5 million, half of which would be furnished by the new navigation district. By 1912, financing was assured and work on the channel was ready to get underway, this time in earnest.⁴⁷

Early in 1912, Charles Crotty was called into the office of the district engineer. Maj. Earl I. Brown asked him how long it would take to estimate and prepare specifications for dredging the Houston Ship Channel to 25 feet. Crotty estimated forty to forty-five days, thirty for making

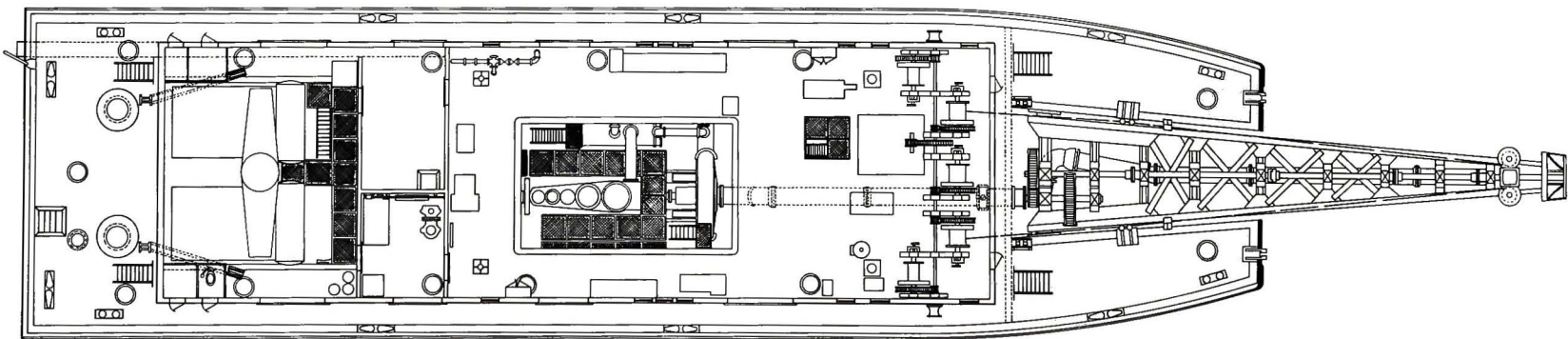
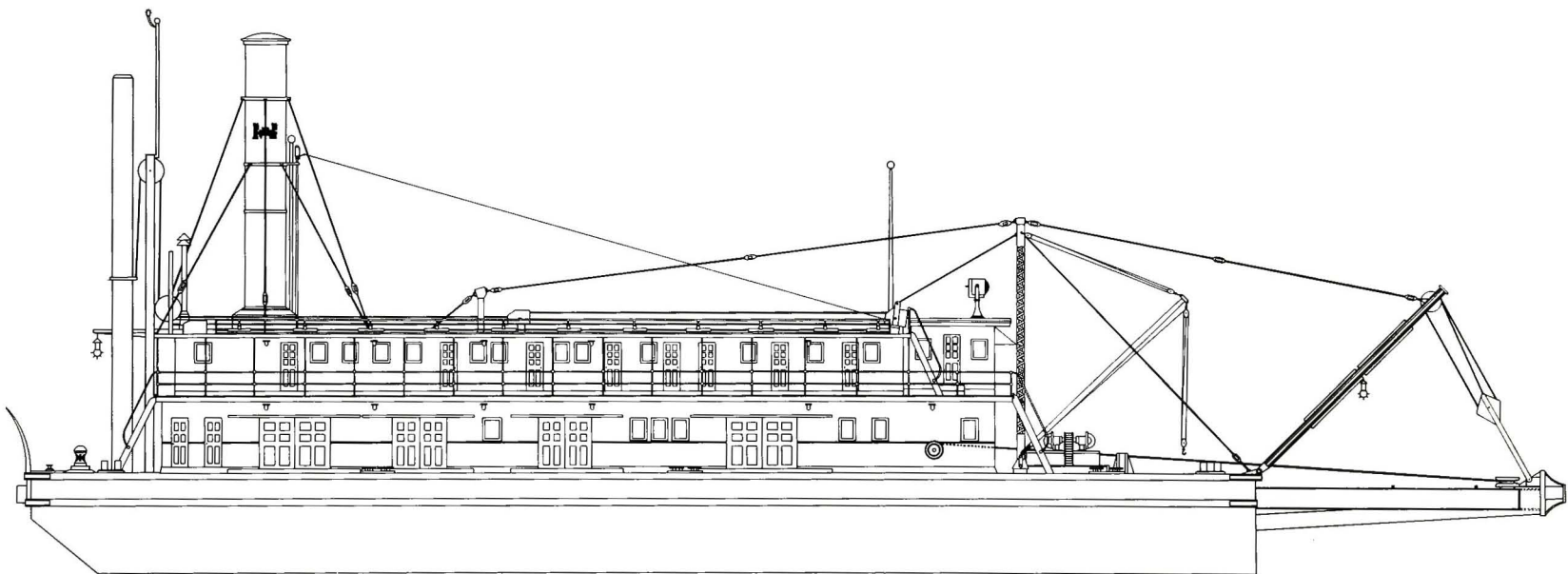
a survey and another ten to fifteen for writing specifications. Brown replied, "Use available data and have specifications on my desk in one week." Major Brown's orders were followed and the estimate made that week differed only 1,341 cubic yards from the total 23 million cubic yards actually dredged. A survey party organized in April under Crotty's supervision remained in the field until work under the contract, awarded in June to the Atlantic, Gulf & Pacific Dredging Company, was completed more than a year ahead of schedule on September 7, 1914.⁴⁸

The first oceangoing vessel to use the new channel was the schooner *William C. May*, 184 feet long and drawing 16½ feet of water; she docked at the Southern Pacific wharves at Clinton on September 26. The second, the Bull Line steamer *Dorothy*, 290 feet long and drawing 19 feet, received an official welcome on October 12. On November 10, 1914, President Wilson pushed a pearl-topped button in Washington to set off cannon on the banks of the turning basin, marking the formal opening of the Houston Ship Channel.⁴⁹

Houstonians soon learned that it would take more than a 25-foot channel to attract commercial vessels. Several major setbacks followed the opening of the ship channel. Captains of large vessels were reluctant to venture into an unknown channel, potential world war threatened to cut sharply into export trade, and public shipping facilities were lacking. To remedy this last deficiency, the voters went to the polls on October 28, 1914 and approved a \$3 million bond issue for construction of wharves, warehouses, and terminal facilities.⁵⁰

The Southern Steamship Company initiated regular coastwise service between Houston and New York (later moved to Philadelphia) in August of 1915. The 312-foot-long *Satilla*, drawing 22 feet, made the first run. For her arrival which was anticipated on August 19, a "monster celebration" was planned. Col. C. S. Riché was among the scheduled speakers. The event never came to pass, however, due to a severe storm that swept through the area. The *Satilla* rode out the ordeal in the Gulf, arriving at the turning basin on August 22.⁵¹

For the Galveston District, the losses caused by the raging hurricane were particularly tragic. The *San Jacinto* and the *Sam Houston*, two recently completed government hydraulic pipeline dredges which had been constructed for channel maintenance, sustained more than \$72,000 worth of damage. The quarterboat that had been moored at Morgans Point also fared badly. It had furnished home and headquarters for Charles Crotty's survey party ever since the large-scale operations begun in 1912 had required continual survey activities. This "floating office" could be towed to different sections of the channel as the work progressed.⁵²





The quarterboat

Commodore E. M. Hartrick, who had served with the Galveston Engineer Office since as early as 1888, was among those aboard the quarterboat when the storm moved in at Morgans Point. Semiretired and disabled by failing vision and frail health, Hartrick had functioned as a consultant to the survey party while the channel was being deepened. As the winds intensified and the waters rose nearly to the top of the creosoted pile wharf, the men were advised to leave the quarterboat. Hartrick refused, stating emphatically that he had ridden out many such storms and would “rather be afloat than ashore.” Four other men remained with him until the high winds dashed the boat against the piling, breaking the hull. When the boat began to sink, the men donned life preservers and set out to swim the 50-foot distance to shore. Hartrick refused assistance saying it was “every man for himself.” Although he almost reached the shore, the strong current and lethal debris proved too much for him and he perished in the attempt. C. M. Wood, who later became project engineer for the Houston Ship Channel, was swept along the embankment until he

Opposite page: Construction drawings of main deck and outboard profile for 20-inch hydraulic pipeline dredges San Jacinto and Sam Houston, built in 1915 (Traced from original photostat)



Harrisburg Field Office

managed to grasp a small bush to which he clung until the next morning when the water subsided. Another of the men was able to climb into an empty water tank where he spent the night. The other two men became tangled in the telephone wire between the quarterboat and the nearby field office building and were able to pull themselves to safety.⁵³

The quarterboat was rebuilt after the 1915 storm and returned to Morgans Point; in 1923, it was relocated at Harrisburg and hooked up to the electricity line there. This boat served as the Harrisburg Field Office until a concrete office building replaced it in the early 1930s. The Harrisburg office was maintained until the mid-1950s, when the number of area offices was reduced and Houston Ship Channel operations were transferred to the Fort Point office on Galveston Island.

The outbreak of World War I created an urgent need for regular army officers to be reassigned to the war effort. For the Corps of Engineers, this meant shifting many district engineers overseas and leaving senior civilian engineers in charge. When Galveston's Col. E. N. Johnston was called into the field, Raphael Chart Smead, a Reserve Corps officer, was brought in to succeed him. From October 16, 1917 until January 24, 1919, "Major" Smead served as Galveston's only civilian district engineer.⁵⁴

Departing from the West Point tradition of his father and grandfather, Smead had been educated mainly in the public schools. From 1878 until

1885, he worked as a surveyor and engineer for some of the railroad lines spreading across the country. He joined the army engineers in May, 1885. Attached to the office of the Washington Aqueduct in the District of Columbia, he superintended maintenance and operation of the aqueduct. In August, 1905 he was transferred to the new Dallas District, where he worked until his appointment to Galveston in 1917. After he was replaced by Col. Spencer Cosby at the end of the war, Smead served as principal assistant engineer in the Galveston District until November 28, 1919, when he succumbed to apoplexy in the course of his regular duties at the Trust Building.⁵⁵

Industrial Influx

Before the end of the war, another generation of visionary Houstonians was once again projecting into the future; the Houston Ship Channel was about to turn a corner in its development. R. C. Smead appreciated the change that was imminent. Recognizing that Houston's identity as a distribution center would be modified by the industrial growth then gaining momentum, Smead wrote:

The future of the Houston Ship Channel appears to lie in the direction of industrial development as its banks furnish very favorable locations for industries which would thus be given the advantage of water transportation. On account of the difficulty of widening the channel after these industries have located and built improvements, it seems advisable to now prepare a project for future development which can be adopted and adhered to in future.⁵⁶

Already, in 1918, twenty-two industries had located along the channel below the turning basin and sixteen above it. Oil interests were quick to point out that the peculiar requirements of the petroleum-refining industry — “not only deep water, but abundant fresh water, large acreage, sufficient elevation to insure protection from floods and where the hazard of tropical storms is minimized” — could be met on the Texas Coast only along the Houston Ship Channel west of Morgans Point and along the Sabine and Neches rivers below Orange and Beaumont.⁵⁷

The mechanics of transporting oil furnished additional incentive for channel improvement. As the importance of petroleum was growing, so too were the vessels that carried this vital commodity. By 1918, tankers with drafts of 25 to 30 feet were prevalent; but on the Houston Ship Channel, crude oil was being moved in oil barges 125 to 200 feet long, 30 to

38 feet wide, and with drafts varying from 6 to 14½ feet.⁵⁸ Unable to use the larger and more economical tankers on the channel, oil interests were clearly operating at a disadvantage. Consequently, they led the movement for deeper water.

Considering these developments, army engineers advised deepening the channel to 30 feet, widening it in the bay to 250 feet and in the river section to 150 feet, plus enlarging the turning basin and the stretch in front of the wharf at Manchester. Congress authorized these recommendations in 1919; by 1926, the channel had been dredged to accommodate the larger vessels.⁵⁹

Dredging operations on Galveston Bay during the 1920s were not always routine. One crew brought up part of the cable that Commodore Morgan had stretched across his canal fifty years earlier. Other experiences bordered on the hilarious. One old-timer recalls a particularly turbulent occasion when the barge stationed alongside the dredge was unable to turn around because of the excessively strong current. Attempts to buck the tide were futile and the dumping crew, responsible for positioning of the barge, finally decided to let the wind do the job for them. The barge was secured to the dredge by lines running from either end of the vessel. The crew figured the man holding the line at the windward end of the barge would release his rope, and the barge, carried by the swift current, would swing around into the desired position. When everything was ready, the man directing the operation cupped his hands around his mouth and shouted, "Let 'er go, Charlie!" She went — so far and so fast, it took two weeks to find her. Their leader had overlooked one small detail: both of the men manning the lines were named "Charlie."⁶⁰

In the middle of this decade, a young lieutenant was assigned to the Galveston District. Twenty years later, he would profoundly affect the course of world history. While attached to Galveston, Leslie R. Groves served a tour of duty on the Harrisburg quarterboat, for a duration considered "too long" by the other men aboard the vessel. This man, who in 1942 was pegged to direct the development of an atomic bomb, was unsurpassed at getting the job done, but he lacked those qualities that would have endeared him to his fellow workers. One day he was out with a crew working in the bay when the weather became very rough. The captain of the vessel decided it would be wise to return to shore, but Groves disagreed and ordered him to keep on going. As the weather continued to worsen, the captain asserted that as long as they were afloat he was in command and that once they were safely ashore, Groves might exercise his authority. Whether Groves was more influenced by this line of reasoning or by the crew member who stood ready to throw him overboard remains questionable, but he did acquiesce.⁶¹



*Lt. Gen. Leslie R. Groves
(U.S. Army Photograph)*

Above the Long Reach turning basin, the 6½-mile stretch of channel up to the foot of Main Street was used for light-draft navigation. Under provisions of the rivers and harbors act of 1907, this channel was dredged and snagged to dimensions of 8 by 40 feet in 1908. Redredged by the city of Houston in 1914, it supported considerable local traffic between the municipal wharves at Houston and the neighboring towns down the waterway. In 1918, 529,000 tons, consisting of sand, lumber, hardware, groceries, grain, cotton, oil and oil products, and shell, were moved along this channel. Several years later, it had deteriorated to a depth of 5 feet and, in 1925, Congress authorized enlargement to dimensions of 10 by 60 feet. Improvements since that time have mainly involved easing of bends and making one major cutoff at Turkey Bend.⁶²

Throughout the 1920s, Houston aggressively pursued port expansion with a continuous building program and promotional activities. The results were apparent by 1930. Houston had surpassed her old rival, Galveston, ranking first in the nation for cotton exports. Oil and grain also comprised significant portions of the commerce that traveled along the channel. Houston placed third among U.S. ports for foreign exports.⁶³

From then on, the story of the Houston Ship Channel becomes one of continuing enlargement. The channel's articulation with the Gulf Intracoastal Waterway augmented the steadily growing volume of traffic and, in 1932, army engineers recommended deepening to 32 feet. Within another three years, the board of engineers recommended and Congress

authorized a project providing for 34-foot depth plus further widening and easing of bends.⁶⁴

World War II once again interrupted shipping operations and new appropriations, but it brought to the Houston Ship Channel a spurt of industrial development, most notably the petrochemical industry which grew out of wartime production of synthetic rubber. Irish Bend Island was made into a shipyard which turned out Liberty Ships at a staggering rate and other industries joined in the defense effort. At the end of the war, many installations along the bayou that had been operating for the government were converted to private enterprises. From 1946 to 1950, Col. Wilson G. Saville, a former Galveston district engineer, served as chairman of the navigation district board. In 1948, Houston ranked second in tonnage among U.S. ports and Congress authorized a 36-foot-deep project.⁶⁵

To offset rising competition, enormous expansion and modernization of port facilities were undertaken in 1957, followed the next year by adoption of a 40-foot project depth. In Galveston Bay, a shallow-draft, 5-mile cut eastward, 8 by 125 feet, was completed in 1960, eliminating 9 miles of travel distance for barges operating between the ship channel and Trinity Bay.⁶⁶

At present, Houston ranks third among the nation's ports in tonnage handled. More than 89 million tons passed through the Houston Ship Channel in 1974, accounting for almost one-third of the total tonnage moved through Texas ports. A successful example of federal and local cooperation, Buffalo Bayou has been transformed from a meandering stream into a vast industrial complex. Through their role in this waterway's development, Galveston army engineers have shared in the spectacular expansion of the "way station" at the junction of Buffalo Bayou and White Oak Bayou, from a settlement of barely forty-five thousand inhabitants at the turn of the century to three hundred eighty-five thousand in 1940, and to well over a million as the sixth largest city in the country by 1970.⁶⁷

Notes to Chapter 4

¹. *Annual Report of the Chief of Engineers, United States Army, 1912* (Washington, D.C.: Government Printing Office, 1912), p. 692 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).

². Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), pp. 48-53.

³. *Ibid.*, pp. 68-70.

⁴. *Ibid.*, p. 68.

⁵. *Ibid.*, pp. 74-76.

⁶. *Ibid.*, pp. 79, 83-85.

⁷. *Ibid.*, pp. 87-88.

⁸. *Ibid.*, pp. 92-93.

⁹. *Ibid.*, p. 94.

¹⁰. Rivers and Harbors Act of July 11, 1870, ch. 240, 16 Stat. 223; *ARCE*, 1871, pp. 533-36.

¹¹. *Ibid.*, p. 535.

¹². *Ibid.*, pp. 535-36.

¹³. *Ibid.*, p. 536.

¹⁴. *Ibid.*, pp. 535-36, 533; Rivers and Harbors Act of June 10, 1872, ch. 416, 17 Stat. 370.

¹⁵. Sibley, *Port of Houston*, pp. 97-99.

¹⁶. *Ibid.*, pp. 99-100.

¹⁷. *Ibid.*, pp. 100-101; *ARCE*, 1876, pp. 587, 76-77.

¹⁸. *ARCE*, 1877, p. 467.

¹⁹. *Ibid.*, p. 461; Sibley, *Port of Houston*, p. 108.

²⁰. Sibley, *Port of Houston*, p. 105; *ARCE*, 1879, pp. 213-14; Rivers and Harbors Act of March 3, 1879, ch. 181, 20 Stat. 363; Sibley, *Port of Houston*, pp. 109-10.

²¹. Sibley, *Port of Houston*, pp. 105, 108. During the 1880s, the extensive interests of the vast Morgan empire were consolidated into Collis P. Huntington's Southern Pacific Company.

²². *ARCE*, 1883, p. 1080.

²³. *Ibid.*, p. 1078.

²⁴. *ARCE*, 1881, pp. 1342-47; *ARCE*, 1901, pp. 1934-35.

²⁵. *ARCE*, 1896, p. 1548.

²⁶. *Ibid.*

²⁷. *Ibid.*, pp. 1548-49.

²⁸. Sibley, *Port of Houston*, p. 114.

²⁹. H.R. Doc. 99, 55th Cong., 2d sess. (1897), pp. 1-4.

³⁰. *Ibid.*, p. 4.

³¹. *Ibid.*, pp. 4-5.

³². Rivers and Harbors Act of March 3, 1899, ch. 425, 30 Stat. 1121; Act of February 20, 1900, ch. 23, 31 Stat. 31; *ARCE*, 1900, p. 387; *ARCE*, 1901, p. 1933.

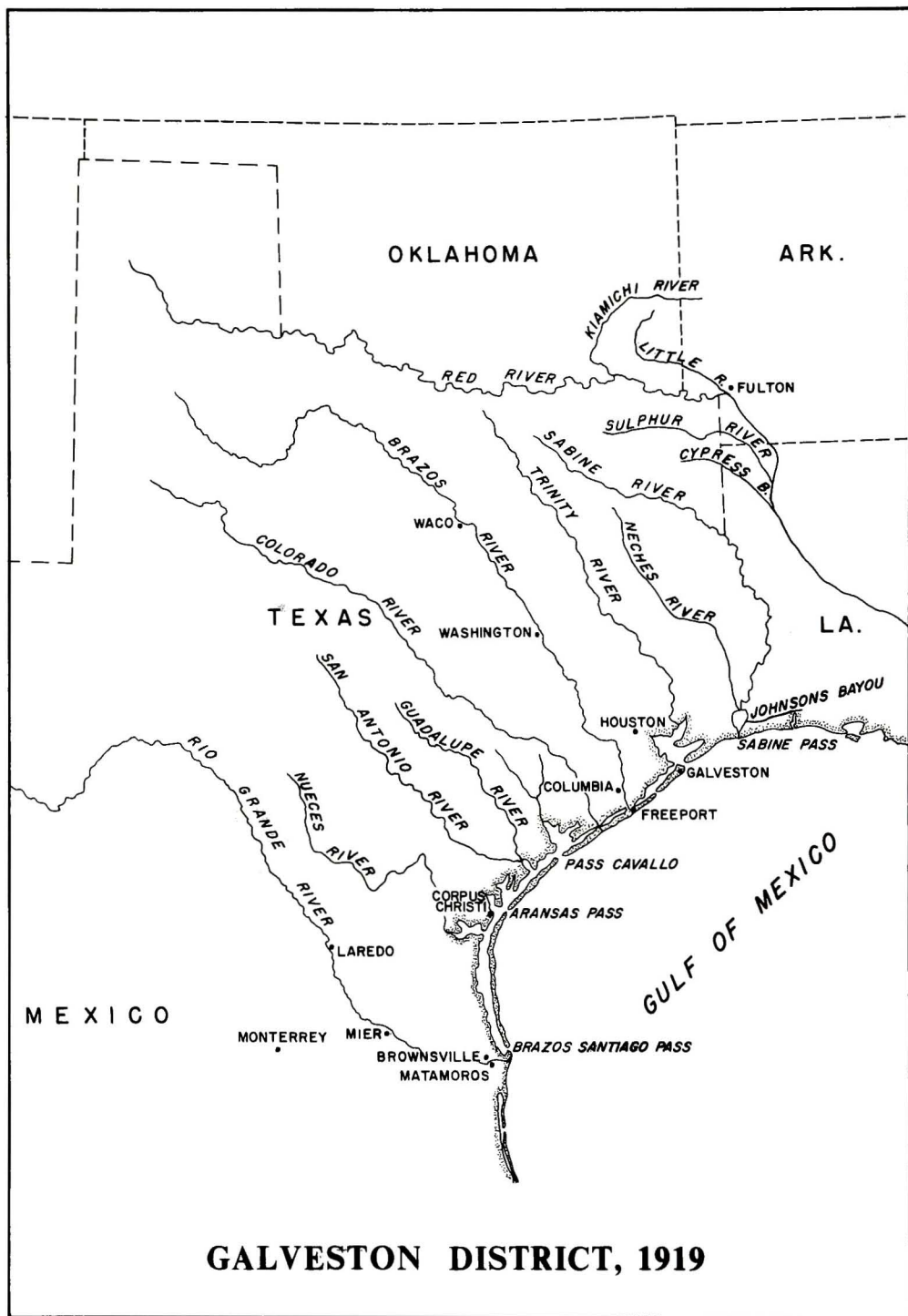
³³. U.S. Military Academy Association of Graduates, *Annual Report*, June 1926, pp. 169-71; *ARCE*, 1901, p. 1933.

³⁴. Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; *ARCE*, 1904, p. 371.

³⁵. U.S. Military Academy Association of Graduates, *Annual Report*, June 1931, pp. 273-74.

³⁶. *Ibid.*, pp. 273, 275.

- ³⁷. Charles Crotty, "Houston Ship Channel, Texas. Construction and Development" (Rough draft, 1946), p. 1, Galveston District Installation Historical Files.
- ³⁸. *Ibid.*
- ³⁹. *Ibid.*
- ⁴⁰. *Ibid.*, pp. 1-2.
- ⁴¹. Sibley, *Port of Houston*, pp. 126-27.
- ⁴². H.R. Comm. Doc. 35, 61st Cong., 2d sess. (1904), p. 2.
- ⁴³. *Ibid.*, p. 1.
- ⁴⁴. *Ibid.*, p. 4; Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117.
- ⁴⁵. Crotty, "Houston Ship Channel," pp. 4-7.
- ⁴⁶. Sibley, *Port of Houston*, pp. 133-37.
- ⁴⁷. *ARCE*, 1912, pp. 696-98, 2002.
- ⁴⁸. Crotty, "Houston Ship Channel," pp. 9-10; *ARCE*, 1912, pp. 2002-03.
- ⁴⁹. Sibley, *Port of Houston*, pp. 144, 146-147.
- ⁵⁰. *ARCE*, 1915, p. 875.
- ⁵¹. Sibley, *Port of Houston*, pp. 149-50.
- ⁵². *ARCE*, 1916, p. 934; Crotty, "Houston Ship Channel," p. 7.
- ⁵³. Crotty, "Houston Ship Channel," p. 15.
- ⁵⁴. *Galveston Daily News*, 17 October 1917; "Memoir of Raphael Chart Smead," *Transactions of the American Society of Civil Engineers* 83 (1921): 2335.
- ⁵⁵. "Memoir of Raphael Chart Smead," *Transactions of the American Society of Civil Engineers* 83 (1921): 2335; *Galveston Daily News*, 30 November 1919.
- ⁵⁶. H.R. Doc. 1632, 65th Cong., 3d sess. (1918), p. 10.
- ⁵⁷. *Ibid.*, pp. 4, 26.
- ⁵⁸. *Ibid.*, pp. 5, 24.
- ⁵⁹. *Ibid.*, p. 3; Rivers and Harbors Act of March 2, 1919, ch. 95, 40 Stat. 1275; *ARCE*, 1926, p. 907.
- ⁶⁰. Interview with W. E. Vandegaer, June 1974.
- ⁶¹. Telephone interview with Jack Beck, October 1974.
- ⁶². Rivers and Harbors Act of March 2, 1907, ch. 2509, 34 Stat. 1073; *ARCE*, 1908, p. 1518; H.R. Doc. 93, 67th Cong., 1st sess. (1921), p. 12; Rivers and Harbors Act of March 3, 1925, ch. 467, 43 Stat. 1186.
- ⁶³. Sibley, *Port of Houston*, pp. 159-60.
- ⁶⁴. H.R. Comm. Doc. 28, 72d Cong., 1st sess. (1932), p. 3; H.R. Comm. Doc. 58, 74th Cong., 1st sess. (1935), p. 3; Rivers and Harbors Act of August 30, 1935, ch. 831, 49 Stat. 1028.
- ⁶⁵. Sibley, *Port of Houston*, pp. 193, 195; H.R. Doc. 561, 80th Cong., 2d sess. (1948), p. 2.
- ⁶⁶. H.R. Doc. 350, 85th Cong., 2d sess. (1958), pp. 7, 44.
- ⁶⁷. *The World Almanac & Book of Facts 1976* (New York: Newspaper Enterprise Association, 1975), pp. 115, 210; U.S. Bureau of the Census, *Statistical Abstract of the United States 1975*, 96th ed. (Washington, D.C.: 1975), p. 24.



Proliferation of Ports

Abolition of the Dallas District in 1919 led to considerable enlargement of Galveston District boundaries. Encompassing far more than the already significant activities along the coast, Galveston's responsibilities were extended to include all works of improvement in Texas plus the Red River in Texas, Oklahoma, and Arkansas above Fulton; Sulphur River, Texas and Arkansas; Cypress Bayou and waterway between Jefferson, Texas and Shreveport, Louisiana; Kiamichi River, Oklahoma; Little River, Arkansas; and Johnsons Bayou, Louisiana. The main coastal legacy from the defunct Dallas District was the Sabine-Neches Waterway. Since 1919, Galveston District alone has borne continuous responsibility for all navigable waters along the booming Texas Gulf Coast.

History of the Texas Coast reveals a pattern that characterized the growth of each major port. First documented in the surveys of 1853, prevailing conditions consisted of bars blocking potentially navigable passes, erosion of the heads of the southern islands at the passes, and corresponding southward shifts in channel locations. Local interests attempted modest and isolated corrective measures after the Civil War, followed by the army engineers, who conducted examinations and surveys in the 1870s and a far-flung program of initial improvements in the early 1880s. After five or six years, most of these withered as it became painfully clear that government resources were spread too thin and that a single western Gulf port should be selected for deep-water improvement.

After 1889, when Galveston was named beneficiary of the concentrated efforts of the government to furnish a port for the "Trans-Mississippi West," a short-lived era of private activity dominated the Texas Coast. Harbor and channel companies were chartered under state law to undertake deep-water channel improvements. Some of these works proved overly ambitious and, for the most part, ruinously expensive for the corporations that sponsored them. Before the turn of the century, most private works had been turned over to the government; army engineers assumed responsibility for their maintenance and, where necessary, their completion.

Chronologically, progression of ports along the coast followed the westward movement of settlement in the state and the extension of the railroads. Such social, political, and economic forces help account for the time span between creation of the deep-water port at Galveston in 1897

and completion of the channel to Brownsville in 1936. During the intervening years, other deep-water ports that had been spawned emerged along the coast in almost east-to-west geographical order.

The Port That Sulphur Made

With the Brazos River running through the region of Texas most conducive to agricultural productivity, early planters naturally looked to this stream as a potential avenue for navigation. Crops of cotton and sugar were cultivated in the fertile fields along the river. By 1832, the Brazos already sustained considerable commerce. Longest river in the state, it differed from most others by emptying directly into the Gulf without an intermediary tidal basin. The Brazos was not, however, an ideal candidate for dependable navigation, impeded by many rocks, shoals, bars, snags, bends, rapids, and variable water levels. A further hindrance lay in the shifting bar, fluctuating in depth from 4 to 10 feet, where the mouth of the river flowed into the Gulf.

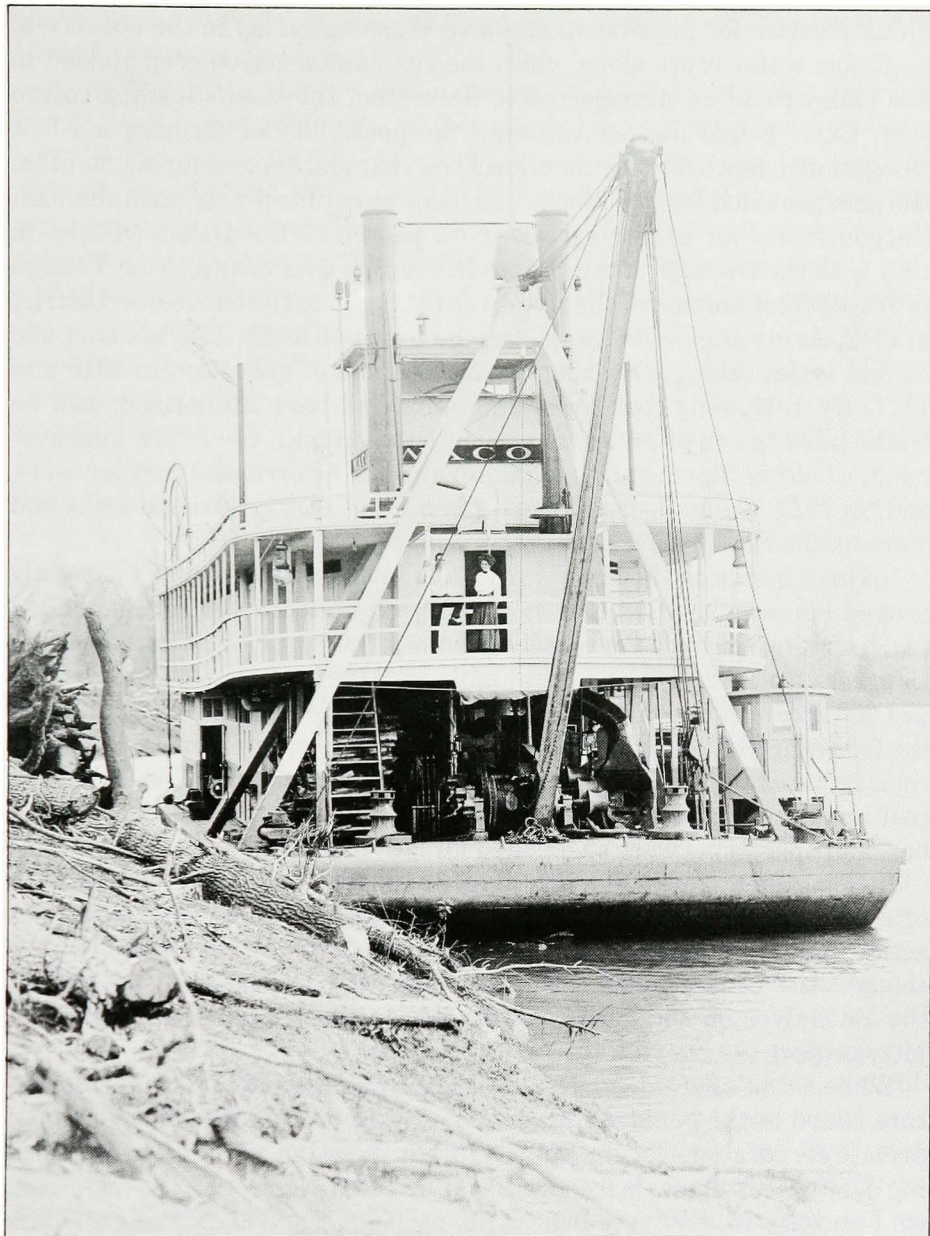
Examining this bar in 1853, Lt. W. H. C. Whiting was not overly optimistic about its improvement:

... one heavy blow of twenty-four hours' duration would neutralize the labor of weeks.¹

Presumably having arrived at the same conclusion several years earlier, the Galveston and Brazos Navigation Company was chartered on February 8, 1850, to build an inland canal linking the river with West Galveston Bay and thereby avoiding the bar. Envisioned by Stephen F. Austin as early as 1822, this canal was completed in the middle 1850s to a depth of 3½ feet. The 50-foot-wide canal could accommodate steamboats, rafts, and other small craft. Initially successful, it was gradually neglected as dredging costs proved prohibitive for the company and capital was diverted to the glamour stock of the day, the railroads.²

In the years 1857-58, Texas spent \$60,000 to improve the Brazos from its mouth upstream about 250 miles to Washington, the head of high-water navigation during favorable seasons of the year. This improvement was insufficient; by 1874, when R. B. Talfor surveyed the 430 miles from the mouth to Waco, he noted that only two steamers ran as high as Columbia, representing "the entire commerce of the river." Houston had tapped the trade of the upper Brazos and drawn it away from the river above Columbia, the head of low-water navigation.³

Snag boats were put into operation below Washington in the early 1900s. The only major effort to improve the river above Washington was



U.S. snagboat Waco on Brazos River

initiated by the rivers and harbors act of 1905, which authorized examination of the 175 miles from Old Washington up to Waco.⁴ The Galveston District conducted this examination.

Justification for improvement above Washington lay in the absence of a suitable water route along which the substantial cotton crop yielded in this valley could be transported to Galveston, the state's leading cotton port. Capt. Edgar Jadwin reported the possibility of securing a 4-foot navigational depth for four months of the year and 3½ feet for six months. His plan provided for eight locks and dams plus 103 miles of open channel. Responsibility for executing this work passed to the Dallas District in 1907 with the transfer of the Brazos River above its mouth (from Velasco to Waco). This portion of the river was returned to the Galveston District in 1912. Army engineers completed the first two locks, 170 feet long and 55 feet wide, taking over their maintenance and operation in 1915 and 1917. By 1918, only four locks and dams had been authorized; still no traffic plied the river and none was anticipated until the entire improvement would be finished. Wartime operations interrupted further work and, in 1922, Congress abandoned the scheme of navigational locks and dams on the Brazos River altogether.⁵

Improvements at the river's mouth followed a course that ultimately proved more fruitful. In March of 1872, Captain Howell recommended that converging jetties of closely driven palmetto piles be constructed. Congress first authorized federal improvement on June 14, 1880, with a \$40,000 appropriation for jetty construction. Major Mansfield began work the following year on brush, stone, and concrete parallel jetties. By 1886, construction was but partially completed, only 27 percent of the estimated cost had been expended, adequate depth had not been obtained over the bar, and operations were suspended for lack of funds.⁶

In September, 1887, Maj. Oswald H. Ernst reported the disappearance of a considerable part of the northeast jetty due to subsidence, wave action, and teredo devastation. Discouraged by these results, Ernst thought the Brazos could better be opened to commerce by deepening the old Galveston and Brazos Canal. He recommended abandoning the jetty project.⁷

While Ernst's recommendation was being considered, the state legislature added to the general statutes a new chapter authorizing creation of private corporations for the purpose of constructing, owning, and operating deep-water channels from Gulf waters to safe harbor on the mainland. On February 16, 1888, the Brazos River Channel and Dock Company was organized, receiving authorization from Congress on August 21 to improve the mouth of the Brazos. From 1889 to 1896, this company was engaged in building two parallel jetties, 560 feet apart, and several wing dams or spur dikes along the river bank to control the currents. It also established a port at Velasco, about 5 miles above the mouth on the eastern bank of the Brazos. Unable to finance completion of the project,

however, the company transferred its works, rights, and privileges to the United States on April 25, 1899.⁸

Taking over this responsibility, the army engineers adopted a project to repair and strengthen the jetties, construct spur dikes, and dredge a channel 18 by 150 feet. By 1908, all but the dredging had been accomplished. The channel, which then ranged in depth from 13 to 19 feet, was not being used commercially; the costly job of dredging was postponed until such time as commercial interests would justify further work.⁹

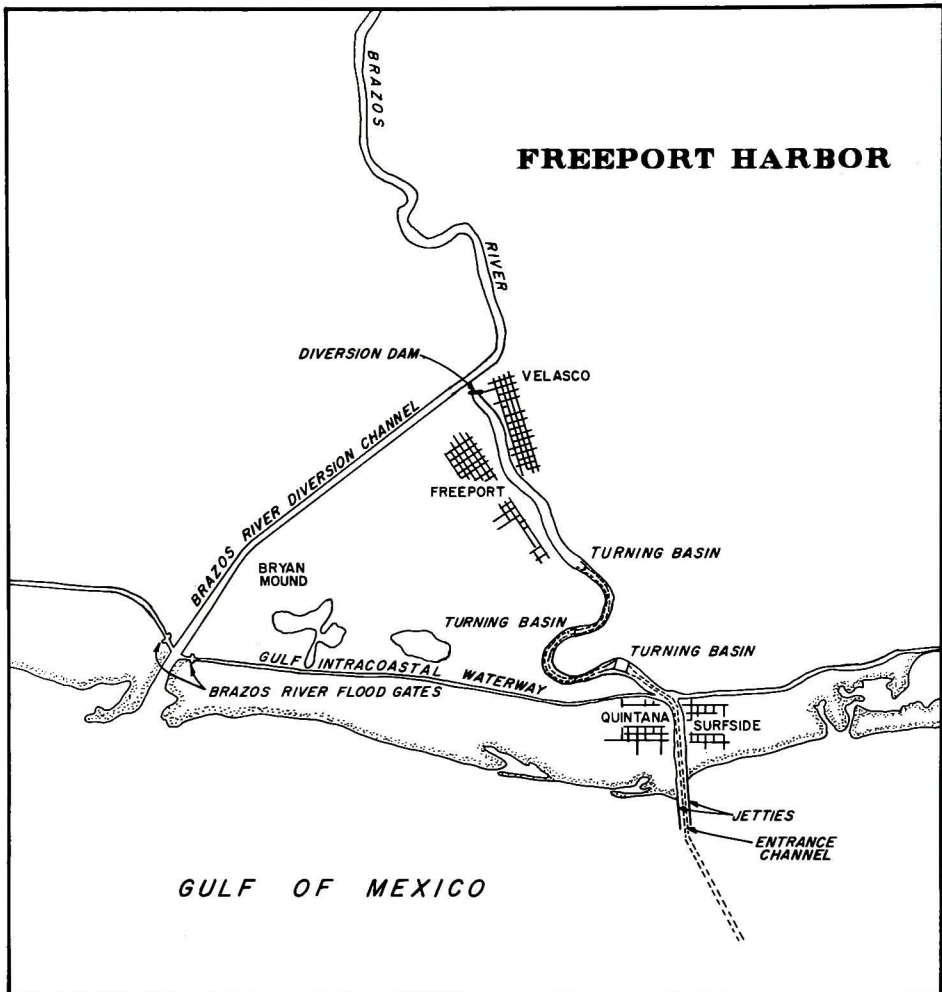
By 1912, the Houston & Brazos Valley Railway had extended its line from Velasco, a town of six hundred inhabitants, down to a point about 1 mile above the end of the jetties and the Corps had just finished dredging a channel to the railway wharf. The railroad company had purchased the steamer *Honduras*, to make regular runs between New York and the Brazos River. Because of the prevailing depth at the latter, 18 feet or less, the ship was often compelled to call at the ports of Port Arthur or Galveston and discharge part of its cargo before proceeding to the Brazos.¹⁰ While the commerce generated by this operation represented an increase, it was still insufficient to justify more extensive government improvement at the mouth of the Brazos, and Galveston District Engineer Maj. Earl I. Brown stated,

As a competitor with the port of Galveston, only 45 miles away, I do not believe the mouth of the Brazos will ever amount to much unless some additional advantages are given to it.¹¹

In the same report, Major Brown followed this gloomy prediction with announcement of a new development on the Brazos horizon which indeed brightened future prospects for this locale.¹²

Four miles west of the river mouth, an extensive deposit of sulphur had been discovered. In 1912, construction was already in progress on a plant for extracting the sulphur and a New York syndicate was preparing to launch the Freeport Sulphur Company. The eastern capitalists, controlling all land adjacent to the river, planned to develop a town, a port, and diversified industrial growth. The proposed port would "be free" with "no wharfage or other charges being imposed on commerce."¹³ With the sulphur company as its backbone, Freeport was in its infancy, but on the verge of a growth spurt.

Within barely two years, conditions at the mouth of the Brazos had changed considerably: the town of Freeport had been established several miles above the jetties on the west bank of the river, an additional steamer had been added to the line running to New York, and the Missouri, Kansas & Texas Railway had acquired trackage to the port.¹⁴ The thinking of the



army engineers had changed too, as manifested by this statement by a member of the board of engineers reviewing studies preliminary to securing a 25-foot depth:

Much stress has been laid upon the necessity of better port facilities at this point, not only because of the growing local commerce, but on account of material benefits that would result to a large portion of the State of Texas by reason of an additional competitive port. It appears that at times there is considerable congestion in the port of Galveston, which operates to the disadvantage of the shippers and jobbers through a large section of the State. It has been represented that the



Jetties and harbor at Freeport

terminals at Galveston are under such control as to make the wharfage charges and the transfer of freight unduly high, and that this difficulty would be largely alleviated by a deep-water port at Freeport by virtue of its being in fact a free port.¹⁵

Soon the Corps was improving Freeport Harbor with a project for a “reasonably permanent channel about 22 feet.” The area was growing and

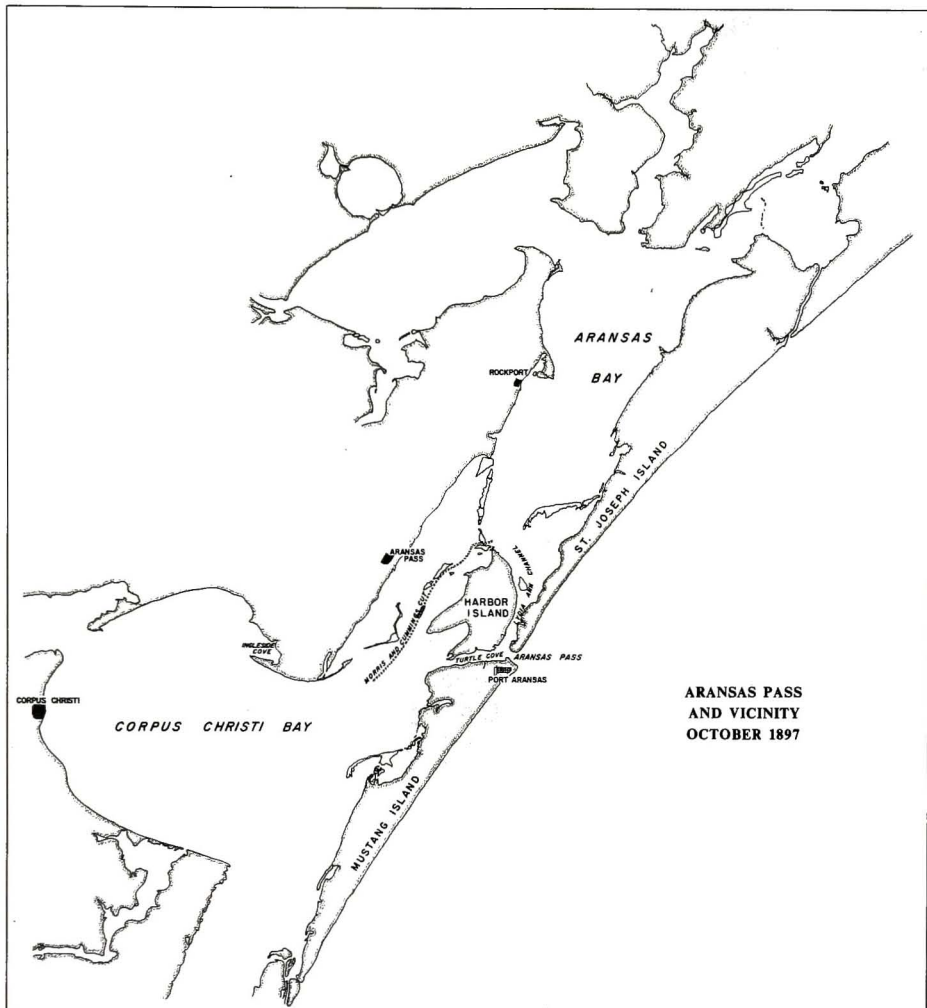
industrializing, but channel maintenance was proving problematic. The lengthy Brazos River was subject to torrential floods and sudden rises. When these occurred, the river carried great quantities of silt downstream, thereby counteracting improvements achieved by dredging at the mouth. After evaluating a number of alternatives, the engineers found a solution in a diversion dam 7 miles upstream and a diversion channel flowing into the Gulf west of the natural channel. This plan was authorized by Congress on March 3, 1925 and the project was completed in September, 1929. As a result, the Brazos found a new outlet to the Gulf and the original mouth of the river was afforded protection that would insure its development into a major coastal port.¹⁶

Subsequent years witnessed the success of Freeport Harbor. The Corps of Engineers gradually enlarged the channel. New industries moved in; by the middle 1950s, chemical and petroleum companies had supplanted sulphur in accounting for the principal economic activity at Freeport. Turning basins were added and in 1954 the Brazos River Harbor Navigation District constructed Brazos Harbor, a terminal facility extending west of the federal channel. In 1958, Galveston army engineers added Brazos Harbor to their maintenance responsibilities. The most recent development in Freeport's history was authorization for a 45-foot channel depth in 1970.¹⁷

Progress at Aransas Pass

When the illustrious Lt. George B. McClellan reported on his survey of the bars from the mouth of the Rio Grande to Pass Cavallo in 1853, he expressed unqualified pessimism about their prospects for improvement. The difficulties and complications that attended future developments at Aransas Pass and its adjacent bays probably would not have surprised him. An involved series of improvements was begun by the Aransas Pass Road Company in 1852 and continued by a number of other private corporations. The only notable early accomplishment was a channel, excavated by the city of Corpus Christi under an 1854 authorization from the state legislature, to connect Corpus Christi and Aransas bays. This 7-mile-long channel proved inadequate, however, and the city later contracted with the firm of Morris & Cummings to dredge an 8-by-100-foot channel. Completed in 1874 and known thereafter as the Morris & Cummings Cut, this channel ran along the inshore side of Harbor Island and connected with Aransas Pass through the Lydia Ann Channel which lay between Harbor Island and St. Joseph Island.¹⁸

The first improvement at Aransas Pass itself was attempted in 1868 by the citizens of Rockport, 12 miles north of the pass. They subscribed



\$10,000 and built a 600-foot-long dike on St. Joseph Island; however, when army engineers surveyed the pass in 1870, no trace of this work remained. After a second survey conducted in 1878, a board of engineers recommended a project including construction of parallel jetties (one extending from the south end of St. Joseph Island, the other from the north end of Mustang Island) and protection for the eroding head of Mustang Island. One member of the board thought a single jetty extending from Mustang Island might suffice, but later experience would demonstrate the necessity for a paired jetty.¹⁹

From May of 1880 until 1885, work at this location was conducted under Major Mansfield. Erosion on Mustang Island, amounting to 260 feet per

year, was significantly reduced to about 70 feet annually by construction of seven groin jetties together with a breakwater and mattress revetment along the channel face of the island. The project also included locating sand fences on the heads of both islands, planting trees on St. Joseph Island, and building a south jetty 5,500 feet long. This jetty, known as the "Mansfield jetty" or the "Old Government jetty," was constructed of brush mattresses and stone, with high portions of inshore superstructure temporarily capped with piles and stones. The jetty started at Mustang Island and ran out to the *Mary*, from which it continued on by a sharp curve northward. The *Mary*, a Morgan Line sidewheel steamer, had been wrecked on November 30, 1876.²⁰ Despite recommendations of engineers during the early years of the district, the *Mary's* wrought iron hull has remained at the site where it sank, lying submerged just south of the present main channel.

Many years later, Maj. Gen. Lansing H. Beach, recently retired chief of engineers, wrote Maj. (later Maj. Gen.) Julian L. Schley, then district engineer at Galveston. The former chief of engineers shared with the future chief his reminiscences of Aransas Pass:

When I first saw that locality in 1884 it was very different from what it is today. Then the only communication was a Morgan Line steamer about once in ten days. Sometimes they would stop, or rather slow down and let one climb aboard, sometimes not, . . . I had some rare experiences getting around that part of the world and sometimes went hungry, but it was great "life in the open"; open was about all there was to it sometimes.²¹

Major Ernst made a new survey in March, 1887, soon after he arrived at Galveston. Reporting that the protection of Mustang Island had only partially accomplished its objective, he advised giving top priority to laying an 18-inch-thick riprap cover. This revetment, completed by May, 1889, prevented further erosion and was found to be in good condition when examined in 1897.²²

As for the jetty, Ernst found it had settled badly and had not produced a significantly deeper channel. He submitted a project for two parallel stone jetties, 2,000 feet apart out to the 20-foot curve. The south jetty he proposed would incorporate the Mansfield jetty to a point a little beyond the *Mary*, from which it diverged to the southeast and continued out in a straight line.²³

Although a board of engineers approved the Ernst project on July 19, 1887, these jetties were never built. At first the limited funds made available were applied to the more urgently needed Mustang Island revetment. Soon after this protective work was finished, the selection of

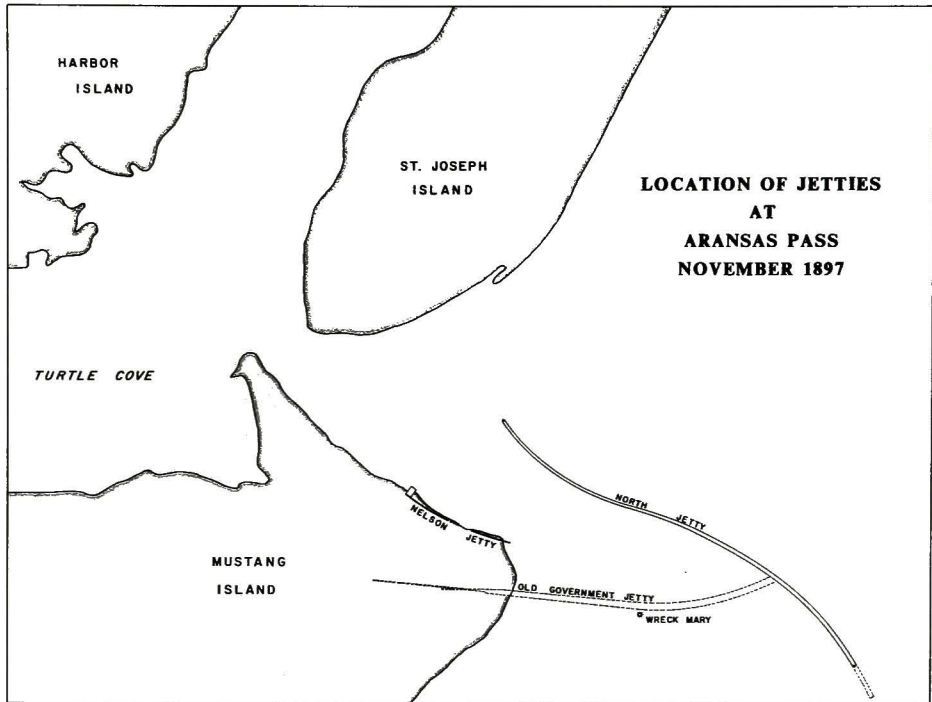
Galveston as *the* deep-water harbor to be developed on the Texas Coast drew away major appropriations that had been hoped for at Aransas Pass and other incipient ports. Consequently, several private corporations were chartered about that time, but only one made lasting harbor alterations at Aransas Pass.²⁴

The Aransas Pass Harbor Company, incorporated on March 22, 1890, received congressional approval on May 12, 1890 to build and own structures necessary to achieve a 20-foot-deep channel across the outer bar. The state granted the harbor company the right to purchase land on portions of Harbor and Mustang islands at the rate of \$2 per acre, dependent on the company's securing 20 feet over the bar by the year 1899.²⁵

The harbor company erected two jetties. The first, called south or Nelson jetty, was built about 1892 and located some 600 to 1,000 feet nearer the channel than the line of the old Mansfield jetty. Consisting of a row of light cylindrical wooden caissons which were 7 feet in diameter and filled with sand and stone, this jetty extended 1,800 feet from the company's wharf on Mustang Island.²⁶

The second and principal jetty, known as the north or Haupt jetty, was built between August, 1895 and September, 1896. Plans and specifications for this stone jetty were furnished by two consulting engineers, Prof. Lewis M. Haupt of Philadelphia and H. C. Ripley of Galveston. Ripley may be remembered as the civilian engineer who conducted surveys under Captain Howell as early as 1874 and remained with the Galveston Engineer Office until 1891. At that time, he parted company with the government and set up practice as a civil engineer, specializing in "hydrographic surveying, plans, estimates and specifications for harbor improvements, and other marine works."²⁷ In this capacity, he would again be called upon to serve Galveston after the turn of the century.

The plan drawn up by Haupt and Ripley conflicted with Ernst's plan and differed from the usual form of jetty, "being detached from the shore and located on the bar to the 'windward' of the channel." Furthermore, the jetty axis was to be "curved (compound and reverse) to produce reactions similar to those found in the concavities of streams." The consulting engineers were confident that construction of a "definite portion" consisting of 3,750 feet would produce a 15-foot depth and that completion of the jetty to a total 6,200-foot length would yield 20 feet. About three-quarters of the work on the Haupt jetty was completed, but the jetty failed to create the anticipated depth. In September, 1896, the company contracted with C. P. Goodyear to provide a 20-foot channel in any way he could. Goodyear used 23,350 pounds of dynamite to blast a channel, some 13,000 pounds being used to blow out about 500 feet of the old Mansfield jetty which then crossed the channel at a 45-degree angle and ran into the line of the new Haupt jetty, but he too failed to deepen the channel.



Finally, the company, having spent \$401,554.18, had exhausted all its funds and was obliged to cease operations; it had obtained for all practical purposes no more than 8.5 feet of navigable depth.²⁸

In November, 1897, a board of engineers headed by Col. Henry M. Robert examined the works of the Aransas Pass Harbor Company to ascertain their character and value to the government. The board found the scant remains of the Nelson (south) jetty greatly debilitated. The Haupt (north) jetty posed an altogether different problem. The engineers viewed the plan proposed by Ernst ten years earlier as "the proper method of improving this pass to its full capacity." The structures existing in 1897, however, precluded implementation of Ernst's plan; estimated costs for removing the entire Haupt jetty were prohibitive. Thus, the board devised a plan which called for removal of only the outer portion of the Haupt jetty, utilizing the rest of it as a north jetty in conjunction with a new south jetty to be built; at the same time, the board expressed these reservations:

... the improvement of this pass has been greatly complicated by the works constructed by the Aransas Pass Harbor Company, and the pass will never be as good as it would have been had these works never been constructed. . . .²⁹

The rivers and harbors act of 1899 authorized the government to take over the company's works, assessed by the board to have a value of "nothing," and to remove the Mansfield jetty from its outer end to the wreck of the *Mary*.³⁰

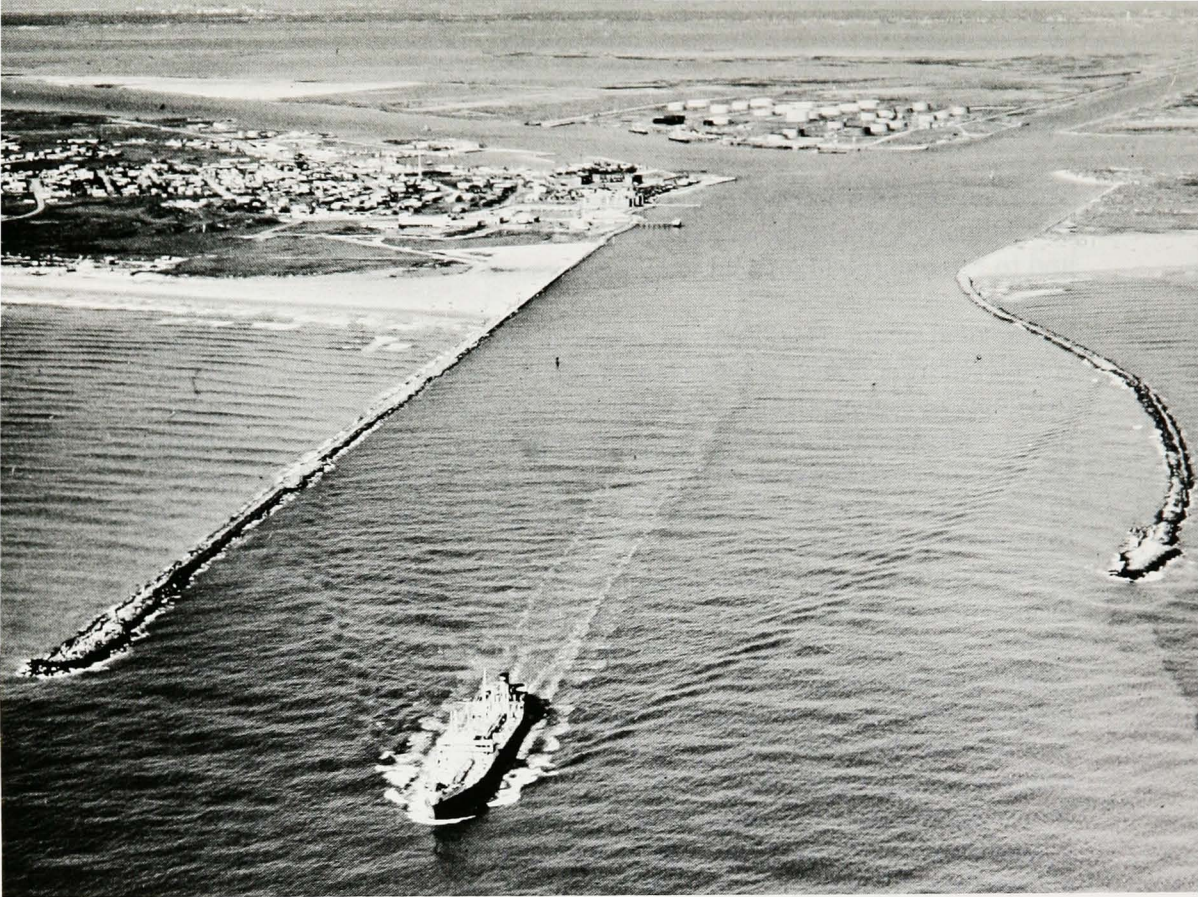
Removal of the Mansfield jetty was a long, drawn-out affair. Work completed by contract in 1904 was considered to have removed 1,000 feet to a depth of 25 feet. In fact, although the old jetty had indeed been broken up, the channel remained shoal; later engineers believed that the scattered stone particles from the jetty prevented scouring action necessary to deepen the channel. Around 1911, the district again turned its attention to removal of the jetty.³¹

The task proved no easier this time around. Scattered stone had to be located and removed before the channel could be effectively dredged. The "junior engineer" stationed at the Port Aransas suboffice on Mustang Island indicated the only way this could be accomplished was "to sound around with an iron shod pole and when rock is found place the dredge and remove the same." Pressures on District Engineer Col. C. S. Riché to complete this project prompted him to stretch his verbal ingenuity as he wrote the engineer at Aransas Pass to "please see that all the 'pushancy' needed is applied." The harassed junior engineer seems to have adopted a regimen of personal "pushancy," later informing Riché, "I personally sleep on the job and am on the work every morning before daylight."³² Early in 1915, removal of the old jetty to a point 1,000 feet from the north jetty was once again considered complete. The work had been accomplished to within 300 feet of the wreck *Mary* and shoal conditions prevented further operations.

After the Aransas Pass Harbor Company relinquished its improvements and rights on March 27, 1899, the Corps of Engineers decided to complete the north jetty in accordance with Haupt's plans and specifications. This work, authorized in 1902 and 1905, was completed by June 11, 1906.³³ Conditions continued to deteriorate, however, with the channel

. . . approaching dangerously near the [north] jetty, and finally a secondary channel, 600 feet wide and 6 feet deep, broke through the gap between jetty and shore with the result that for all practical purposes the channel was on the north side of the jetty instead of the south side, as intended . . .³⁴

Thus, the engineers were forced to come to grips with the inadequacy of a lone jetty and the undesirability of the gap between the jetty and St. Joseph Island; the result was authorization in 1907 for construction of a south jetty and an extension connecting the inshore end of the Haupt jetty



Aransas Pass jetties

to St. Joseph Island. By 1919, the north and south jetties had reached their present lengths of 9,241 feet and 7,385 feet, respectively.³⁵

As the channel finally began to deepen, a suitable harbor to accommodate the ships navigating the channel became the next priority; army engineers proceeded to establish a roadstead at the Harbor Island basin, opposite the entrance channel through the pass. They also constructed a stone dike on the unstable St. Joseph Island to prevent the emergence of unwanted passes that tended to cut through from the Gulf across into Aransas Bay following severe storms. This structure was designed to concentrate, and thereby increase, tidal flow through Aransas Pass. By 1916 the levee extended 20,991 feet from its junction with the north jetty. The year 1913 saw authorization for a 25-foot jetty channel and for a 12-foot approach channel from the Harbor Island basin to the town of Port Aransas on Mustang Island. The approach channel was completed in 1914 and dredging in the jetty channel was continued by the seagoing hopper dredges *Galveston*, *Charleston*, and the new *Comstock*, put into service in March, 1916. Concerned that proximity of the channel to the north jetty might jeopardize this structure, the engineers decided in 1920 to

straighten the channel by the addition of four riprap spur dikes, constructed by December, 1922.³⁶

Nature intervened about this time. The area around Aransas Pass had not been beset by a major storm in the thirty years since 1886; local residents had tended to forget the destructive effects of earlier hurricanes and to underemphasize the importance of an adequately protected harbor. Two storms, one in 1916 and a more violent sequel in September, 1919, served as painful reminders that this area was just as vulnerable as were other points along the coast.

On June 5, 1920, Congress authorized preliminary examination and survey of the vicinity "with a view to the establishment of a safe and adequate harbor."³⁷ The towns of Rockport, Aransas Pass, and Corpus Christi vied for this designation. It was understood that only the port selected would require a deep-draft channel.

Three channels then connected Aransas Pass with the mainland. The shortest, a 6-mile passage with dimensions of 8½ by 75 feet, had been dredged in 1909-10 by the Aransas Pass Channel and Dock Company; it extended from the docks on Harbor Island, across the island, to the town of Aransas Pass. A 13-by-80-foot channel to Rockport extended 10 miles from the head of the pass; this channel had been dredged by the Engineer Department for the U.S. Shipping Board Emergency Fleet Corporation in 1918-19. The Aransas Pass-Corpus Christi Channel ran through Turtle Cove and across Corpus Christi Bay, some 21 miles. This channel had first been improved under the rivers and harbors act of 1907 to 8½ by 75 feet; in 1910, Congress adopted a 12-by-100-foot project, which was completed in 1914. By 1920, this channel had shoaled considerably and was not being extensively used, the principal activity being barge transportation of Mexican fuel oil.³⁸

Of the competing communities, Corpus Christi offered the greatest advantages. Although this city's population had dropped from fifteen thousand to ten thousand after the 1919 hurricane, its citizens wasted no time in taking steps to prevent another such disaster and began building a breakwater that would protect its waterfront. Necessitating the longest channel from the pass, Corpus Christi nevertheless had a number of compelling points in its favor — service by four railroads, three banks, ample room for expansion, and plans for an enterprising navigation district. With cattle ranches to the west, farm ranches to the north, and fish and oysters in the adjoining bays, the city was destined to grow and flourish. Diversification of agricultural efforts in the surrounding areas added rice and varied food produce to the principal commodities of cattle, corn, and cotton. Discovery of natural gas near Corpus Christi promised still more economic benefits.³⁹



Old Corpus Christi Area Office

The fabulous King Ranch had gained a foothold between Corpus Christi and Brownsville, responsible to an immeasurable extent for bringing transportation, population, and economic enterprise to South Texas. Robert J. Kleberg, ranch manager and son-in-law of the pioneering Capt. Richard King, provided leadership to the Deep Water Harbor Association for South and West Texas plus funds enabling Roy Miller to lobby in Washington on behalf of a port at Corpus Christi. In 1922, these efforts bore fruit.⁴⁰

Corpus Christi was selected. A 25-by-200-foot channel through Turtle Cove and across Corpus Christi Bay was begun in January of 1925 and completed in July of the following year.⁴¹ On September 14, 1926, Corpus Christi officially opened its harbor to commerce.

Even before the new channel was finished, the Galveston District recognized the advantages of opening a permanent field office at Corpus Christi. While final operations on the channel were handled from the suboffice at Port Aransas, negotiations for suitable sites were entered into with the Nueces County Navigation District. When transfer of land was completed in 1929, construction began on the new field office, garage, warehouse, wharf, and bulkheads. The white, latticework office building sat on a bluff overlooking the ship channel and housed the Corpus Christi Area Office until a new structure was erected across the street in 1974. The responsibilities of this office have increased over the years to include maintenance of 328 miles of dredged channels.

Spectacular growth accompanied the new port at Corpus Christi. By 1929, the city's population (twenty-six thousand) had more than doubled since 1920 when the harbor improvement was recommended. Commerce on the waterway jumped from 96,000 tons in 1922 to 4,216,000 tons in 1929. Cotton and oil comprised a major portion of this total. The water-

way, too, was destined to grow. Authorized depths gradually increased from 30 feet in 1930 to 45 feet in 1968.⁴²

In September, 1934, local interests completed dredging a 7,374-foot-long industrial canal, 30 by 100 feet, and an equally deep turning basin at Avery Point, 800 by 1,000 feet. Maintenance and future improvement of these additions were turned over to the Corps of Engineers in 1935. Three years later, Congress authorized the army engineers to extend the canal another 4.2 miles to a turning basin near Tule Lake; authorization followed in 1958 for a further 2.2-mile extension (Viola Channel) and turning basin at Suntide Refining Company. The same act gave the government engineers responsibility to maintain and improve the shallow-draft Jewel Fulton Canal and turning basin, privately dredged from La Quinta Channel through Ingleside Cove to Kinney Bayou.⁴³

Early in 1953, Reynolds Metal Company completed plant facilities on a 1,700-acre site with 2,700 lineal feet of shoreline frontage along the north shore of Corpus Christi Bay. The \$122 million complex was designed to process aluminum ore (bauxite) into alumina, which would then be reduced into aluminum metal. The operation required 2,000 tons of bauxite daily. The company planned to transport the ore by ship from its mines in Jamaica, West Indies, and was constructing a vessel specifically for this purpose, with a deadweight capacity of 13,150 tons and a draft of 27 feet 9 inches when loaded. To accommodate such vessels, Reynolds requested a 32-foot branch channel, from the Corpus Christi Channel to the company's wharf at La Quinta, and a turning basin at the plantsite.⁴⁴

Army engineers rejected a bay route in favor of a 6-mile course running along the shore; this route offered the advantages of 50 percent lower annual maintenance costs and protection for local fishermen, afforded by a continuous embankment of excavated material between the channel and the bay. The shore route would also aid in industrial development of 5 miles of prime, waterfront property on high ground with adequate supplies of fresh water and natural gas. That a channel to La Quinta would promote the production of aluminum, a vital defense metal, further justified it from the standpoint of national defense.⁴⁵

Construction of the channel, 32 by 150 feet, was authorized in 1954 with provision for local interests to contribute 50 percent of the cost. Congress did not appropriate funds at that time, however. Because of the urgency of putting the ore fleet into operation, the Nueces County Navigation District and Reynolds Metal Company proceeded jointly to dredge a channel 32 by 125 feet, completed in 1954. By 1956, the plants were being enlarged; anticipated expansion of operations and government plans to stockpile bauxite required larger ships and a correspondingly larger channel. Further enlargement of La Quinta Channel to dimensions of 36



Corpus Christi Harbor

by 200 feet was recommended. In a departure from standard procedure, the chief of engineers also recommended reimbursing the local interests \$953,400, the difference between the amount they had expended in their work on the channel and the 50 percent contribution required for the "single user" channel. Deepening to 36 feet was authorized and completed in 1958 and the unusual reimbursement was indeed made a couple of years later.⁴⁶

By 1964, the four port installations (Harbor Island, Ingleside, La Quinta, and Corpus Christi) on the 40-mile waterway were handling commerce approaching 30 million tons composed of 62 percent in petroleum and related products, 26 percent in ores, and about 6 percent in grains. Shipments of petroleum, the principal outbound commodity, moved coastwise; ores constituted the major imported commodity, increasing more than fivefold since 1955. Deep-draft grain shipments tripled during this period. Half of this was composed of grain sorghum, which had ascended greatly in importance after 1956-57, with development of a high-yield hybrid seed by the Texas Agricultural Experiment Station and the United States Department of Agriculture. The trend toward larger bulk cargo vessels and supertankers provided a salient reason for the waterway to be enlarged again. In 1968, a 45-foot project was adopted to accommodate the fully loaded requirements of vessels ranging up to 59,000 deadweight tons with loaded drafts of 41 feet.⁴⁷

El Paso de los Brazos de Santiago

On a July day in the year 1523, the bay at the southernmost pass along the future Texas Coast received the lilting denomination "Brazos de San Iago" (Arms of Saint James). Fittingly named for the patron saint of warriors, Brazos Santiago, as it came to be called, has been host to a tumultuous history, uniquely shaped by its proximity to the Mexican border. The narrative of this harbor and the region it serves has been liberally enriched by those elements that make for romantic and fascinating retelling. Across the pages of the Lower Rio Grande Valley history march legendary heroes of war and revolution, giants of the frontier and ranching industry, audacious outlaws and sordid profiteers; their exploits are set against a background of shifting allegiances, economic and political power struggles, smuggling and illegal enterprises, international intrigues, and hotheaded uprisings followed by vindictive reprisals. The arduous development of this vicinity suffered many setbacks from the unstable scene along the border, undoubtedly delaying the arrival of sound and legitimate commercial well-being.

Existence of the passage between Brazos and Padre islands had been first documented by Alonso Alvarez de Piñeda in 1519, but the sun-

**BRAZOS SANTIAGO AREA, 1929,
AND FUTURE CHANNELS**

MATAMOROS

BROWNSVILLE

RIO GRANDE R.R. LINE

BROWNSVILLE TURNING BASIN

CHANNEL 1

RIO GRANDE

LAGUNA

POINT ISABEL

BRAZOS IS.

MADRE PADRE IS.

MAMOROS

BROWNSVILLE

BROWNSVILLE TURNING
BASIN

RIO GRANDE RR LINE

BROWNSVILLE

R 10

GRANDE

LAGUNA

POINT ISABEL

MADRE

PADRE IS.

BRAZOS

drenched, sandy shores along the pass saw little port activity for almost another three centuries. Originally serving colonists of Spain and later of Mexico, the port at Brazos Santiago was not actually opened to foreign trade until 1823, when ranchero Martín de León sailed in with a load of luxury merchandise from New Orleans. From then on, it served as the principal port for the trade of southern Texas and northern Mexico. Dry goods were shipped in and specie, hides, skins, and wool were shipped out.⁴⁸

Strategic advantages of Brazos Santiago resided in the shortcomings of the Rio Grande itself. Some appreciation for the devious course of this river may be derived from the fact that while the Mexican town of Mier, head of navigation during the 1840s, was located 175 miles from the Gulf by land, it required a tedious, 250-mile excursion by riverboat.⁴⁹ The mouth of the winding river was very shallow, obstructed by a shifting sand bar, and afforded poor anchorage. About 8 miles from the river mouth, the bay of Brazos Santiago (Brazos Island Harbor) offered convenient anchorage. Merchandise unloaded there was transported overland by muleback or oxcart to the river, where it nourished the growth of Matamoros, Mexico, center of the thriving Rio Grande trade. One historian's account describes the tremendous importance of the port:

The real reason Mexico wanted the territory between the Nueces and the Rio Grande, the real reason for the bitterness and for the war upon that issue, was not twenty-five million empty acres of grassland between the two rivers. It was the location of the little port of Brazos Santiago, the only practicable funnel through which commerce poured into northern Mexico.⁵⁰

Despite its limitations, the Rio Grande supported for a time an extremely lucrative riverboat commerce engaged in the transport of goods and supplies to the ranchos and military outposts upriver. The most successful of these operations was conducted for almost a quarter of a century by the renowned team of Mifflin Kenedy and Richard King. In 1850, these enterprising young men countered the various impediments to navigation by devising a system based upon two different types of ships, both of which were designed by King and built to his specifications. An "outside" steamer, heavy enough to withstand the harsh abuse of Gulf turbulence, hauled cargoes from Brazos Island Harbor to the mouth of the river and 10 miles upstream to a terminal called White Ranch. There, cargoes were transferred to an "inside" vessel, designed with easy handling for maneuvering the succession of curves to be encountered as it

steamed up the river with a loaded draft of less than 24 inches. During high water, the outside vessel might eliminate the one transshipping operation by proceeding directly up to Brownsville, opposite Matamoros. The economy effected by this system wiped out overland transportation; the dual steamboat operation dominated commerce along the Rio Grande until the early 1870s, when the railroads finally presented competition the riverboats could not meet. The Rio Grande Railroad Company, running 22 miles from Point Isabel to Brownsville, brought to a close the era of navigation on the troubled and troublesome river.⁵¹

The Texas Mexican Railway, connecting Corpus Christi, Laredo, Monterrey, and Mexico City, inaugurated rail service in 1881. Thus cut off from the commercial mainstream, the bypassed city of Brownsville entered into a period of economic decline; correspondingly, port activity diminished at Brazos Santiago. This coincided roughly with the arrival of the army engineers in the area. River and harbor improvements at Brazos Santiago proceeded at a desultory pace in keeping with the economic ills of the Lower Rio Grande Valley. The year 1878 marked the first federal improvement when the engineers removed debris from the wreck of a bark, the *Réne des Mers*, from the harbor. In the early 1880s, Major Mansfield began constructing a south jetty at the pass; this jetty extended a length of 3,955 feet when lack of funds brought the work to a halt.⁵²

As the only avenue for the meager commerce of the locality, the little port was served by light-draft vessels from Galveston and New Orleans and by the 22-mile, narrow-gauge Rio Grande Railroad between Point Isabel and Brownsville. In 1904-05, the Corps of Engineers furnished further improvement by excavating a 10-by-70-foot channel from deep water inside the bar, across the Laguna Madre, to and including a 300-by-400-foot turning basin at the Point Isabel railroad wharf.⁵³ This permitted light-draft steamers and sailing vessels that could cross the bar to unload at the wharf rather than having to be lightered off Brazos Island.

Not until 1904 when the St. Louis, Brownsville & Mexico Railway, spearheaded by the interests of the King Ranch, linked Brownsville with Corpus Christi, did Brownsville begin its recovery from the years of geographic isolation. The port at Point Isabel, however, was slated for even harder times. The new railway obtained control of the narrow-gauge Rio Grande Railroad Company line and, "after having disposed of most of its equipment permitted it to deteriorate to such an extent that dependable train service was out of the question." The steam lighter *Luzon* was allowed to sink just off the railroad wharf so as to put the turning basin out of commission and prevent freight transfers, allegedly an act of sabotage

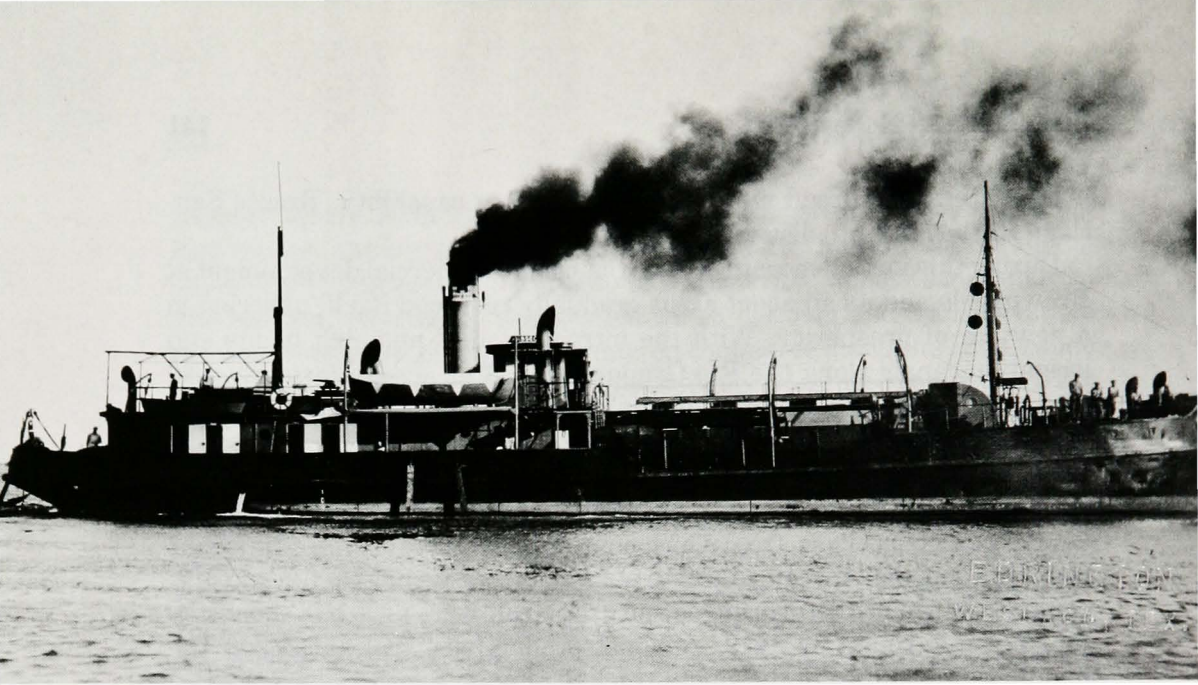
perpetrated by railroad men to impair shipping capability. Brazos Santiago Harbor fell into disuse.⁵⁴

During this virtual moratorium at the port, commercial development at Brownsville and its adjacent areas gradually reversed itself, ushering in a new era of prosperity. With the introduction of pumping plants and irrigation canals along the Rio Grande, acre after acre of formerly arid land became cultivated and began yielding new crops. Fuel for the pumping and other local plants came from about 150,000 barrels of Mexican crude oil imported annually. Ironically, the oil-carrying vessels traveled by water from Tampico, passing within sight of Brazos Santiago, and landed at Aransas Pass, from which point the oil completed its roundabout route to the valley by rail, at a rate of forty-one cents per barrel. In 1910, commercial quantities of oranges and grapefruit were picked in the valley for the first time. By 1919, regional productivity had surpassed the handling capabilities of the single-track St. Louis, Brownsville & Mexico Railway. During one season, thousands of tons of cabbage and other vegetables rotted in the fields and in railroad cars. In 1912, the railroad was reported to have paid in the vicinity of \$90,000 to settle claims for perishable freight which the line had accepted and proved unable to transport. Finally, the St. Louis, Brownsville & Mexico Railway sold what remained of the Rio Grande line at auction in 1917. This transaction brought the line under the control of the citizens of Brownsville.⁵⁵

Renewed appeals by Brownsville interests in 1919 were forceful enough to convince the federal government that at least tentative harbor improvements were justified. Congress approved an experimental, five-year project to dredge an entrance channel 18 by 400 feet through the pass, provided local interests finance dredging of a 16-by-100 foot channel from just inside the pass to the turning basin at Point Isabel. Further, local interests were to pay for maintenance of their portion of the improvement, to rebuild the Rio Grande Railroad to standard gauge, and to furnish suitable terminal facilities.⁵⁶

The experimental project got underway in 1923, with dredging first inside the pass and later outside. The outer bar at Brazos Santiago has been considered the roughest along the Texas Coast, largely due to the more abrupt slope of the sea bottom and the greater proximity of deep water.⁵⁷ Dredging there constituted an exercise in futility. On one occasion, a dredge that had worked its way in through the pass had to turn around and redredge its way out.

To enable the government hopper dredge *Absecon* to operate safely in the entrance channel, two short stone dikes were erected by June of 1927. The structure starting from Padre Island extended 1,700 feet; that from



U.S. hopper dredge Absecon dredging first jetty channel at Brazos Santiago, 1926

Brazos Island, 1,400 feet. During the most favorable weather conditions in August and September, the *Absecon* was delayed by the uncovering of an old wreck in the middle of the channel.⁵⁸ This may have been the time when the dredge hit a submerged object and damaged its suction pipes. A diver sent down from Galveston to investigate the obstruction found a large wooden sailing vessel about 15 feet below the surface. The ship, named *Queen of the Seas*, was laden with a cargo of wine. Destruction of this vessel was recommended to clear the channel.

A great quantity of dynamite was placed on the upper deck from stern to bow. When the charge went off, it sent a column of water skyward that was seen miles away. The concussion of the blast caused the cork stoppers of the wine bottles to pop out. The stoppers floated to the surface, the sea-water took on a pinkish cast, and the air was fragrant with the odor of fine old wine that had aged sixty years in the hull of the vessel.⁵⁹

Dredging operations were concluded by the end of 1927, the channel continued to reshore rapidly, and the project was discontinued in 1928.

Clearly, permanent improvement at Brazos Santiago called for a more aggressive approach. By this time, a minimum depth of 25 feet would be appropriate to accommodate commercial vessels. Disagreement prevailed, however, over the proper site for the harbor. After a public

hearing at Brownsville on November 21, 1928, three navigation districts were formed: Brownsville, Port Isabel-San Benito, and Arroyo Colorado. Port Isabel-San Benito interests argued for locating the harbor at Point Isabel, which officially changed its name to Port Isabel in that year. Brownsville interests sought instead a direct channel from the pass to terminate at a turning basin 4 miles from the city.⁶⁰

A new Brazos Island Harbor project, authorized in 1930, represented a compromise in that Brownsville and Port Isabel-San Benito both gained their own respective channels and turning basins. The two navigation districts paid construction costs amounting to \$1,683,257.70 for all channels inside the pass; the federal government financed jetty construction and the jetty channel. The 25-by-100-foot channel to Port Isabel, which cut off from the straight channel leading inland to Brownsville, and its 600-by-700-foot turning basin were dredged between April 18, 1933 and September 15, 1933. Jetty construction was conducted between November 5, 1933 and February 25, 1935; with funds allotted by the Federal Emergency Administration of Public Works, the north jetty was built to a length of 6,330 feet and the south jetty to 5,092 feet. The U.S. hopper dredge *Absecon*, and later the *Galveston*, deepened the 25-by-300-foot jetty channel between August of 1934 and July 31, 1935. Meanwhile, the job of dredging the new channel to Brownsville and its 1,000-by-1,300-foot turning basin was begun December 20, 1934 and completed February 21, 1936. The new work on the Brazos Island Harbor cost a total of \$5,398,749.71.⁶¹

Status of jetties at Brazos Santiago on August 9, 1934 (Photograph by U.S. Army – Air Corps)





Completed jetties at Brazos Santiago. Brownsville Ship Channel veers to the left in background.

Located at Port Isabel since 1928, the army engineers field office moved to downtown Brownsville shortly after the Brownsville Ship Channel opened. This field office occupied quarters in the Post Office Building on Elizabeth Street most of the time until October, 1972, when the Brownsville Area Office was relocated in a new commercial building, the Boca Chica Towers. During the earlier years, warehouses at the old Fort Brown installation were used for storage by the field office.

The years since 1936 have seen progressive deepening of the channels to the present depth of 36 feet. Interior channels have been widened and both turning basins have been enlarged and extended. By 1946, an additional channel at the junction of the Brownsville and Port Isabel channels was authorized to facilitate movement of vessels between the two ports and to relieve congestion.⁶² A three-basin shallow-draft fishing harbor extending north from the Brownsville Ship Channel has been added to the maintenance responsibilities of the Galveston District.

Today, various industries flank the Brownsville Ship Channel. One, of particular interest to the energy situation commanding so much attention in the 1970s, is a company building offshore oil drilling rigs. These gargantuan structures draw 25 feet of water and present an imposing sight along the channel before they are towed to their distant destinations in the North Sea. Another interesting operation on the channel is conducted by a ship dismantling company. Although shipping operations at Brazos Island



Brownsville Ship Channel, looking toward Gulf from turning basin

Harbor represent a somewhat smaller scale than those of the older ports up the coast, the combined Brownsville-Port Isabel tonnage figures continue to grow. The Brownsville Ship Channel that has replaced the long-gone river steamers and the narrow-gauge Rio Grande Railroad built over a century ago bears little resemblance to the lively and turbulent times that preceded it. Nevertheless, it bustles with a new vitality, distinctive of the area it serves.

Notes to Chapter 5

- ¹ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 567.
- ² Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), p. 65; Earl Wesley Fornell, *The Galveston Era: The Texas Crescent on the Eve of Secession* (Austin: University of Texas Press, 1961), pp. 29-30.
- ³ *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1875* (Washington, D.C.: Government Printing Office, 1875), pp. 934-36 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).
- ⁴ Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117.
- ⁵ H.R. Doc. 705, 59th Cong., 1st sess. (1906), p. 7; Rivers and Harbors Act of September 22, 1922, ch. 427, 42 Stat. 1038; *ARCE*, 1922, p. 1150; H.R. Doc. 298, 66th Cong., 1st sess. (1919), p. 3.
- ⁶ *ARCE*, 1875, pp. 937-38; S. Doc. 138, 54th Cong., 2d sess. (1897), p. 4.
- ⁷ S. Doc. 138, 54th Cong., 2d sess. (1897), p. 4.
- ⁸ *Ibid.*, pp. 4-7; H.R. Doc. 1087, 60th Cong., 2d sess. (1908), p. 7; H.R. Doc. 433, 84th Cong., 2d sess. (1956), p. 12; Rivers and Harbors Act of March 3, 1899, ch. 425, 30 Stat. 1121.
- ⁹ H.R. Doc. 1087, 60th Cong., 2d sess. (1908), pp. 2-3, 7-8.
- ¹⁰ H.R. Doc. 9, 63d Cong., 1st sess. (1913), pp. 3, 9.
- ¹¹ *Ibid.*, p. 8.
- ¹² *Ibid.*, pp. 10-11.
- ¹³ *Ibid.*, p. 10.
- ¹⁴ H.R. Doc. 1469, 63d Cong., 3d sess. (1914), p. 8.
- ¹⁵ *Ibid.*, p. 5.
- ¹⁶ H.R. Comm. Doc. 10, 68th Cong., 2d sess. (1924), pp. 1-3; *ARCE*, 1930, pp. 1094-96.
- ¹⁷ H.R. Doc. 433, 84th Cong., 2d sess. (1956), pp. 1, 3; Rivers and Harbors Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 297; Rivers and Harbors Act of December 31, 1970, Pub. L. No. 91-611, 84 Stat. 818.
- ¹⁸ S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 562; H.R. Doc. 137, 55th Cong., 2d sess. (1897), pp. 8-9.
- ¹⁹ H.R. Doc. 137, 55th Cong., 2d sess. (1897), pp. 5-6.
- ²⁰ *Ibid.*, pp. 3, 6.
- ²¹ Beach to Schley, 4 August 1925, Construction File no. 600/533b, Civil Works Operations & Maintenance Files, Galveston District Retired Records Predating 1940 (hereafter cited as GDRR). Some evidence suggests Beach made an error on his date of 1884. According to district records, Beach served with the Galveston District from 21 August 1893 to 29 October 1894. H.R. Doc. 137, 55th Cong., 2d sess. (1897), p. 5, indicates that up until 1890, the vicinity received regular lines of steamers and considerable trade. This commerce fell off as a result of railroad expansion and development of Galveston Harbor until, in 1897, only a weekly steamer that had been recently put into service ran between Aransas Pass and Galveston. This would further support a case for Beach's meaning instead the year 1894.
- ²² H.R. Doc. 137, 55th Cong., 2d sess. (1897), pp. 7-8.
- ²³ *ARCE*, 1888, pp. 1314-15, 1317.
- ²⁴ H.R. Doc. 137, 55th Cong., 2d sess. (1897), p. 7.
- ²⁵ *Ibid.*, pp. 7, 10.
- ²⁶ *Ibid.*, p. 11.
- ²⁷ *Ibid.*; *General Directory of the City of Galveston 1893-94* (Galveston: Morrison & Fourmy, 1893), p. 382.
- ²⁸ H.R. Doc. 137, 55th Cong., 2d sess. (1897), pp. 33, 11-13; *ARCE*, 1916, p. 976; H.R. Doc. 137, 55th Cong., 2d sess. (1897), p. 14.
- ²⁹ H.R. Doc. 137, 55th Cong., 2d sess. (1897), p. 17.

³⁰. Rivers and Harbors Act of March 3, 1899, ch. 425, 30 Stat. 1121; H.R. Doc. 137, 55th Cong., 2d sess. (1897), pp. 16-18.

³¹. *ARCE*, 1905, p. 396; *ARCE*, 1911, p. 1802.

³². Memo, L. P. Morrison to Lt. Col. C. S. Riché, 21 December 1914, Construction File no. 600/506a, GDRR; Memo, Riché to Morrison, 3 October 1914, Construction File no. 600/493, GDRR; Memo, Morrison to Riché, 15 January 1915, Construction File no. 600/508d, GDRR.

³³. Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117.

³⁴. *ARCE*, 1912, p. 719.

³⁵. Rivers and Harbors Act of March 2, 1907, ch. 2509, 34 Stat. 1073; *ARCE*, 1919, p. 1115.

³⁶. Rivers and Harbors Act of February 27, 1911, ch. 166, 36 Stat. 933; *ARCE*, 1916, p. 977; Rivers and Harbors Act of March 4, 1913, ch. 144, 37 Stat. 801; *ARCE*, 1916, pp. 976-77; Schley to Beach, 24 July 1925, Construction File no. 600/533a, GDRR; "Brief on Experimental Riprap Spurs, North Jetty, Aransas Pass," 22 July 1925, Construction File no. 600/533, GDRR.

³⁷. H.R. Doc. 321, 67th Cong., 2d sess. (1922), p. 2.

³⁸. *ARCE*, 1916, p. 977; Rivers and Harbors Act of March 2, 1907, ch. 2509, 34 Stat. 1073; Rivers and Harbors Act of June 25, 1910, ch. 382, 36 Stat. 630; H.R. Doc. 321, 67th Cong., 2d sess. (1922), pp. 17-18, 20.

³⁹. H.R. Doc. 321, 67th Cong., 2d sess. (1922), pp. 12-13, 19-21.

⁴⁰. Tom Lea, *The King Ranch* (Boston: Little, Brown and Co., 1957), p. 601.

⁴¹. *ARCE*, 1927, p. 977.

⁴². H.R. Comm. Doc. 9, 71st Cong., 1st sess. (1929), pp. 4, 7; Rivers and Harbors Act of July 3, 1930, ch. 847, 46 Stat. 918; Rivers and Harbors Act of August 30, 1935, ch. 831, 49 Stat. 1028; Rivers and Harbors Act of March 2, 1945, ch. 19, 59 Stat. 10; Rivers and Harbors Act of June 30, 1948, ch. 771, 62 Stat. 1171; Rivers and Harbors Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 297; Rivers and Harbors Act of August 13, 1968, Pub. L. No. 90-483, 82 Stat. 731, 732.

⁴³. H.R. Doc. 89, 83d Cong., 1st sess. (1953), p. 18; Rivers and Harbors Act of August 30, 1935, ch. 831, 49 Stat. 1028; Rivers and Harbors Act of June 20, 1938, ch. 535, 52 Stat. 802; Rivers and Harbors Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 731.

⁴⁴. S. Doc. 33, 85th Cong., 1st sess. (1957), p. 11; H.R. Doc. 89, 83d Cong., 1st sess. (1953), pp. 15, 21.

⁴⁵. H.R. Doc. 89, 83d Cong., 1st sess. (1953), pp. 26, 30.

⁴⁶. Rivers and Harbors Act of September 3, 1954, ch. 1264, 68 Stat. 1248; S. Doc. 33, 85th Cong., 1st sess. (1957), pp. 2-3; Rivers and Harbors Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 731; *ARCE*, 1959, p. 711.

⁴⁷. S. Doc. 99, 90th Cong., 2d sess. (1968), pp. 35, 98-101.

⁴⁸. Grant D. Hall and Kerry A. Grombacher, *An Assessment of the Archeological and Historical Resources to be Affected by the Brazos Island Harbor Waterway Project, Texas*, Texas Archeological Survey, Research Report no. 30 (Austin: University of Texas, 1974), p. 29 (hereafter cited as Hall & Grombacher, *Assessment*).

⁴⁹. Lea, *King Ranch*, p. 22.

⁵⁰. *Ibid.*, p. 49.

⁵¹. *Ibid.*, pp. 57-59, 72.

⁵². *Ibid.*, pp. 536-41; *ARCE*, 1879, p. 920; H.R. Ex. Doc. 140, 53d Cong., 3d sess. (1894), p. 2.

⁵³. *ARCE*, 1905, p. 1513.

⁵⁴. Lea, *King Ranch*, pp. 536-41; Hall & Grombacher, *Assessment*, p. 38; H.R. Doc. 1710, 65th Cong., 3d sess. (1919), p. 27.

⁵⁵. H.R. Doc. 1710, 65th Cong., 3d sess. (1919), p. 11; Lea, *King Ranch*, p. 556; H.R. Doc. 1710, 65th Cong., 3d sess. (1919), pp. 27, 8, 10.

⁵⁶. Rivers and Harbors Act of March 2, 1919, ch. 95, 40 Stat. 1275; H.R. Doc. 1710, 65th Cong., 3d sess. (1919), p. 3.

⁵⁷. H.R. Doc. 1710, 65th Cong., 3d sess. (1919), p. 14.

⁵⁸. H.R. Comm. Doc. 9, 70th Cong., 1st sess. (1928), pp. 15-16.

⁵⁹. Joyce M. F. Brogdon, "Surveying the Port of Brownsville — A Brief Glimpse (As told by Mr. James F. Jennings)," Xeroxed (Brownsville: Texas Southmost College, 1974), pp. 3-4.

⁶⁰. H.R. Comm. Doc. 10, 71st Cong., 1st sess. (1929), pp. 12-13.

⁶¹. Rivers and Harbors Act of July 3, 1930, ch. 847, 46 Stat. 918; *ARCE*, 1936, p. 786; H.R. Comm. Doc. 10, 72d Cong., 1st sess. (1932), p. 3; *ARCE*, 1933, p. 609; *ARCE*, 1934, p. 712; *ARCE*, 1935, p. 816; *ARCE*, 1936, pp. 785, 789.

⁶². Rivers and Harbors Act of July 24, 1946, ch. 595, 60 Stat. 634.



Status of the inland waterway, 1906

Navigable Waterways: A Continuing Responsibility

The Great Connection

The advantages afforded by inland waterways were appreciated by the earliest settlers in America. As vital arteries supporting transportation, the streams, rivers, bayous, lakes, and other natural water routes promoted primitive settlement and eventually urban development. They also gave rise to a type of water transportation different from that conducted at deep-water ports. Their shallow, sheltered waters provided safe passage to barges and other light-draft vessels that could not withstand the battering of the open seas, but could be depended upon to link the scattered coastal communities and to penetrate the interior of the country, creating a commercial connection between geographically isolated points.

The canal craze was at its height when the Corps of Engineers first entered the realm of civil works. The vision of a vast network of protected waterways had captured the imaginations of influential men. In 1826, Congress appropriated \$20,000 and authorized a survey for a canal route between the Atlantic and Gulf of Mexico.¹ Thus were sown the first seeds for an intracoastal project that would be in the making for more than a century and would exceed in scope even the extravagant projections of that day. The concept of joining the young nation together by inland navigation began translation into practical canal projects at a time when the Mexican flag flew over Texas, roughly twenty years before Texas was admitted to the Union.

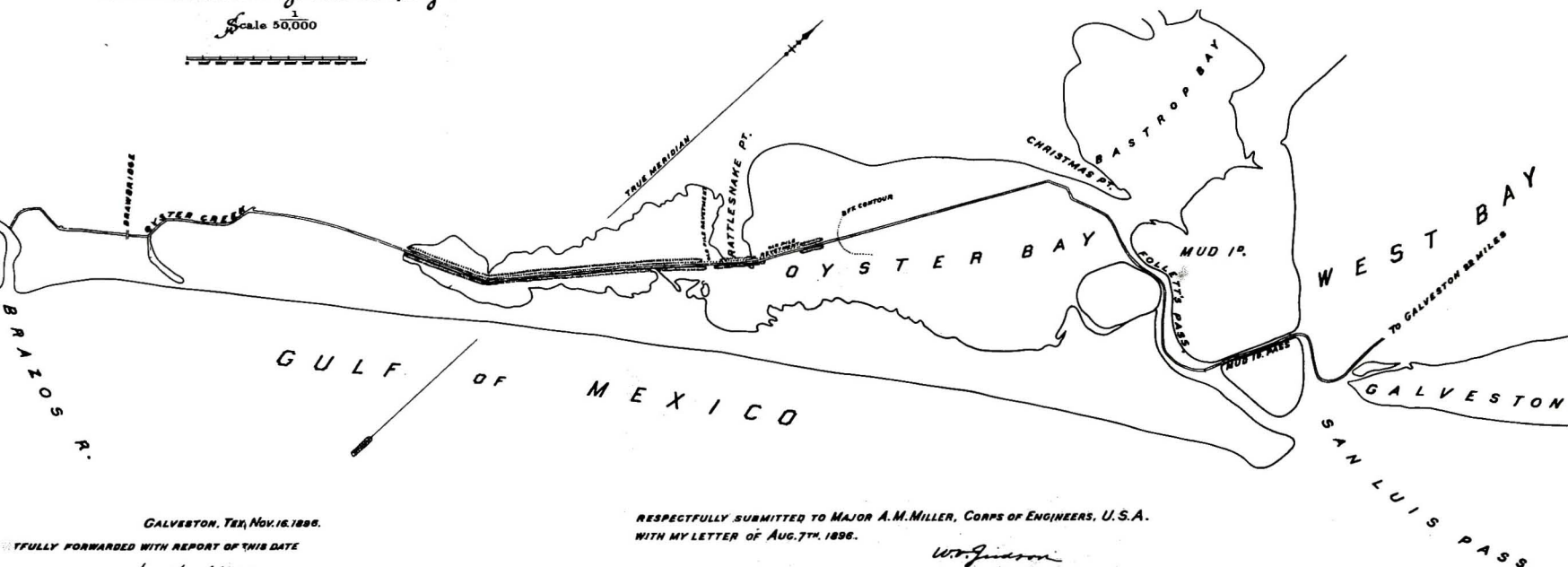
The Texas Gulf Coast was not considered in this grandiose scheme until 1873 when Congress authorized a survey:

For connecting the inland waters along the margin of the Gulf of Mexico, from Donaldsonville, in Louisiana, to the Rio Grande river, in Texas, by cuts and canals, not to exceed twenty thousand dollars²

From his post in New Orleans, Captain Howell delegated the field chores to three civilian engineers. The Louisiana segment was divided between

Channel between
Brazos River and Galveston Bay

Scale 50,000



GALVESTON, TEX, NOV. 16, 1896.

RESPECTFULLY FORWARDED WITH REPORT OF THIS DATE

A. M. Miller

MAJOR, CORPS OF ENG'RS U.S.A.

RESPECTFULLY SUBMITTED TO MAJOR A. M. MILLER, CORPS OF ENGINEERS, U.S.A.
WITH MY LETTER OF AUG. 7TH. 1896.

W. T. Garrison

1ST. LIEUTENANT, CORPS OF ENGINEERS, U.S.A.

First channel between Brazos River and Galveston Bay included 11-mile canal of the Galveston and Brazos Navigation Company, excavated through waters of Oyster Bay and the mainland, and utilizing the bed and waters of Oyster Creek. Constructed in 1850, the navigation company's canal varied in depth from 2 to 7 feet in 1896.

J. A. Hayward, who worked west from the Mississippi River, and H. C. Ripley, who worked east from Sabine Lake. Assistant Engineer James S. Polhemus was assigned the formidable task of surveying the entire Texas Coast. With a party of three men, he ran his transit-line a distance of 50 miles from East Galveston Bay to Sabine Lake between January 28 and April 1, 1873. Characterized by an average elevation of 2 feet, this territory led them through marshy swamplands, infested with "clouds of mosquitoes" and covered with "a dense growth of sea-cane."³

The remainder of the Texas Coast, from West Galveston Bay to the Rio Grande, was surveyed between November 20, 1873 and August 1, 1874. Accompanied by one assistant and four men, Polhemus measured 242 miles as the "almost impenetrable swamps" gradually gave way to "wide and shallow bays, along a wild and almost uninhabited coast."⁴

Two stretches along their route had been altered by man about twenty years earlier. The Galveston and Brazos Canal, connecting the waters of West Galveston Bay and the Brazos River, remained navigable with depths ranging from 3 to 6 feet. Further down the coast, a stream known as Caney Creek, which at one time emptied into the Gulf, had been rechanneled into Matagorda Bay by a 2,850-foot-long ditch. The outlet to the Gulf disappeared and the small ditch gradually enlarged to dimensions of 15 by 80 feet, earning for itself the name of "The Big Canal." Polhemus and his party also traversed several "cuts" connecting bays along the 77 miles between Indianola and Corpus Christi.⁵

Howell based his survey report upon the fieldwork of these "young gentlemen" whom he acknowledged as having "suffered hardships rarely met in the line of their profession." He explained the guiding principle in selecting the route for the proposed 6-by-60-foot canal:

. . . to utilize the navigable bayous, lakes, bays, and sounds or lagoons, near the coast, and make the cuts connecting them along the shortest lines available.⁶

In his report, dated 1875, Howell presented the first plan for an inland waterway beginning at the Mississippi River and terminating at the Rio Grande, where a lock with a double gate and 5-foot lift was deemed necessary.

As so often characterized his luck, Howell had the misfortune to be ahead of his time! His report was relegated to the shelf for the next thirty years; even more time would pass before commerce along the Texas Coast would justify implementation of such a sweeping plan. Meanwhile, growth of the inland waterway progressed in sporadic and piecemeal fashion, geared to the needs of specific locales as they arose.

First Texas Segment

In Texas, the first segment improved by army engineers lay in West Galveston Bay. The state had dredged a channel 5 feet deep across obstructing reefs in 1859, but this passage had deteriorated drastically after the cyclone of 1875 and sustained still more damage from a severe storm in 1886. In 1892, Congress authorized a project for enlarging and straightening the channel to afford depths of 3 to 3½ feet and widths of 100 to 200 feet. Dredging was begun under contract on January 19, 1893, and completed October 2, 1895. The improvement terminated at Christmas (also called Christian's) Point in Oyster (also called Christmas) Bay.⁷

Next, attention shifted immediately southwestward to the canal of the Galveston and Brazos Navigation Company. This 11-mile-long stretch represented the only obstruction to a federally improved, continuous channel between Galveston and the Brazos River. Tolls levied on the river steamboats carrying cotton to market, fishing schooners, and other small craft using the canal made it ineligible for improvement by the federal government. Recognizing the value of this route as an alternative to the troublesome bar at the mouth of the Brazos River, Major Ernst had raised the possibility of acquiring the canal in 1887. Nine years later, Maj. A. M. Miller recommended making this purchase. On February 11, 1897, the navigation company offered the canal to the government for \$50,000. Congress authorized the purchase at \$30,000 and the transaction was completed in December, 1902. Meanwhile, the year 1900 saw reports of surveys and examinations of certain "adjacent streams" — Caney Creek, the San Bernard River, and Oyster Creek — with a view toward incorporating them into a network of protected waterways.⁸

Gradually, but firmly, the idea of an inland navigation system was taking hold. The fragmentation that characterized the progress to that time frustrated incipient economic development along the Gulf Coast. A young banker in Victoria, Clarence S. E. Holland, called a convention that gave birth to the Interstate Inland Waterway League on August 8, 1905. This organization pledged itself to the goal of a continuous system that would tie together the 18,000 miles of navigable waters extending from the Great Lakes, through the Mississippi Valley, and along the Louisiana and Texas coastlines.⁹

Spearheading the new league's program was a vigorous young newspaperman who had come to South Texas the year before, expressly to publicize the attractions of the new community at Kingsville in his capacity as advertising agent for the St. Louis, Brownsville & Mexico Railway.¹⁰ Roy Miller provided capable leadership and devoted himself to



Roy Miller
(Courtesy of Dale Miller)

the intracoastal canal organization over the remaining forty years of his life. A persuasive advocate of the canal in particular and of navigation in Texas in general, he was later instrumental in obtaining appropriations for the deep-water port at Corpus Christi.

The league grew into the Intracoastal Waterway League of Louisiana and Texas, then changed its name to the Intracoastal Canal Association of Louisiana and Texas, and eventually became the Gulf Intracoastal Canal Association as it is known today. From camping on the doorstep of the nation's Capitol to prodding sluggish county governments, encouraging the donation of necessary rights-of-way and the rebuilding of bridges, this association has adhered to its purpose of promoting and insuring the success of the intracoastal canal.

Only a few months before the enthusiastic convention in Victoria, Congress had once again decided to take a comprehensive look at the "inland waterway" from the Rio Grande to the Mississippi River. Maj. Edgar Jadwin conducted the preliminary examination which, in great

measure, retraced the steps of the 1873 survey; Jadwin found a considerable portion of Howell's report still applicable. Jadwin's study, in 1905-06, included two additional surveys: one, from Aransas Pass through Turtle Cove to Corpus Christi, and the other, from Aransas Pass to and up the Guadalupe River.¹¹

The Interstate Inland Waterway League clamored for a channel 9 feet deep to match navigational features on the Mississippi and Ohio valley systems. Acknowledging that a channel this deep might later be required, Jadwin based his project more conservatively on dimensions 5 feet deep and 40 feet wide. He further advised that the southwestern extremity from Corpus Christi to Point Isabel be reconsidered at a future date. The resulting legislation was again fragmented, however, providing only for channels from Corpus Christi to Aransas Pass, Aransas Pass to Pass Cavallo, and another from the Brazos River to West Galveston Bay, all dredged by 1909. Also, the authorization included a tributary channel up the Guadalupe River to Victoria.¹²

National Policy Lends a Hand

During these years, President Theodore Roosevelt, disappointed with progress on the inland transportation system, began calling for more dynamic federal action to improve the nation's natural highways.¹³ In 1908, reexamination of Jadwin's report focused on the unimproved segment between the Brazos River and Matagorda Bay. This review produced a statement by Gulf Division Engineer Col. Lansing H. Beach which seems to reflect a shift toward a more liberal approach:

Even should local conditions not be such as to demand the improvement of this portion of the inland waterways, it is believed that the fact that it is one link in the chain of waterways paralleling the shore of the gulf is of sufficient importance to cause the improvement to be made at as early a date as possible.¹⁴

Congress authorized improvement of this segment in 1910, thereby clearing the way for an uninterrupted channel from Galveston to Corpus Christi. Meanwhile, the more embracing national policy was explicitly underscored by the rivers and harbors act of 1909, which ordered surveys for a "continuous waterway" of enormous magnitude — from Boston to the Rio Grande.¹⁵

Some years later, ever seeking to advance the waterway, leaders of the intracoastal canal association approached Maj. Gen. George W. Goethals,



*Maj. Gen. George W. Goethals
(National Archives)*

the retired army engineer credited with building the Panama Canal. They asked him to recommend some bright young engineer to study the commercial potential of a continuous canal through Louisiana and Texas. When Goethals met with canal association officials the next morning, he declared, "I believe I will take that job myself." In his report, dated November 27, 1923, Goethals estimated that the "present tonnage possibilities of such a waterway are between 5 million and 7 million tons annually, and this statement is conservative."¹⁶ Just how conservative, the years ahead would show!

Two major breakthroughs for the Texas portion of the waterway emerged from Goethals's figures and the subsequent recommendations made by Gulf Division Engineer Col. G. M. Hoffman and Chief of Engineers Gen. Lansing H. Beach in 1924. Incorporation of the segment between the Sabine River and Galveston Bay, authorized in 1925 and completed in 1934, united the Louisiana and Texas portions of the waterway; authorization in 1927 further extended continuous inland navigation

along the Texas Coast, from its eastern border to Corpus Christi. Also, the time had come, as Jadwin predicted, to consider enlargement. Plans for the new Sabine-to-Galveston segment specified a channel 9 feet deep and 100 feet wide, in keeping with eastern and northern channels. In 1927, Congress authorized these larger project dimensions further down the coast.¹⁷

Another development at this time carried profound implications for the route of the future Texas intracoastal canal. In proposing the course of the channel from Sabine to Galveston, Colonel Hoffman departed from the earlier principle of dredging through the open bays. He defended the notion of a landlocked channel, to run along and inside the shoreline, stating:

This route while a little longer and requiring more excavation will cost less for maintenance than other routes previously

Final stages of construction on Sabine River-to-Galveston Bay segment of intracoastal waterway near High Island, April 24, 1934 (Photograph by U.S. Army - Air Corps)



proposed through the bays Experience has demonstrated the difficulty and cost of maintaining the entrance of a canal into a large bay, especially where this entrance lies across the normal currents of the bay Boats using this route will be less exposed to storm conditions in the open bay¹⁸

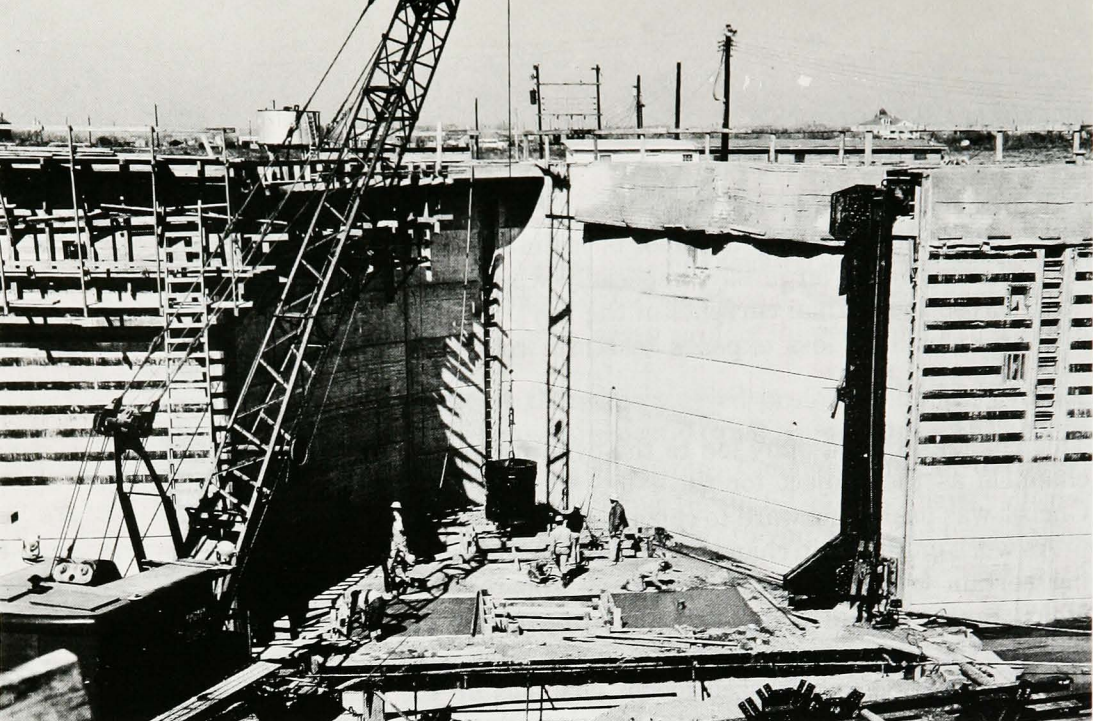
This change in philosophy led to the eventual relocation of many older channels as the project for the 9-foot channel terminating at Corpus Christi was pushed forward to completion in 1942.¹⁹

As work on the main channel progressed, the desirability of constructing certain tributary channels became apparent. Branch channels by which cargoes could travel directly to terminals further inland would enhance the advantages afforded by the growing intracoastal waterway. In 1938, Congress authorized feeder channels up the San Bernard and Colorado rivers plus channels to Palacios, Rockport, and the town of Aransas Pass. By that time, the nature of the commerce evidenced considerable change. Petroleum, petroleum products, iron, and steel constituted the bulk of the traffic, displacing the agricultural commodities for which the canal had been envisioned originally.²⁰

The spirit of the frontier prevailed on the San Bernard River for some time after the tributary channel had been completed. Occasionally, towboats moving too quickly or carelessly along the channel would scrape the banks with the barges they pulled. Viewing this as a threat to their property, individual property owners along the channel resorted to stationing themselves on the banks, armed with rifles, to keep the towboat captains in line. Several incidents occurred in which the irate landowners literally took potshots at the recalcitrant navigators.

The 9-foot project, authorized in the middle 1920s, provided for construction of locks or guard locks where necessary. Two Texas rivers of sufficient magnitude to cause problems intersected the waterway. At the Brazos and Colorado river crossings, the intracoastal waterway was subjected to large intrusions of sediment that washed down the rivers during periods of high discharge, and to excessive currents when the river stages rose. Funds for the necessary protective structures did not become available until the 1942 fiscal year. The Brazos River floodgates were completed in September, 1943, followed within the next year by the Colorado River floodgates, which were placed in operation in August, 1944.²¹

Next, studies were conducted to determine the advisability of converting the floodgates into locks. At the Brazos River crossing, the velocity of the river flowing toward the Gulf posed the major threat to navigation.



Constructing Colorado River locks

But while these currents often caused restrictions to be placed on traffic at this point, the Brazos floodgates did not require as frequent or as prolonged closure as did those at the Colorado River.

For many years, the Colorado River had been plagued by an enormous log raft, about 25 miles long, in the vicinity of Bay City. Between 1925 and 1929, Matagorda and Wharton counties broke up this obstruction to obtain relief from severe flooding upstream. River currents carried debris from the raft downstream where it soon formed a massive delta in Matagorda Bay and created a new flood hazard to the lands adjacent to the intracoastal waterway. To alleviate this problem, in the mid-1930s, the Matagorda County Conservation and Reclamation District No. 1 dredged a channel across the bay and across Matagorda Peninsula, furnishing the river an outlet to the Gulf about 7 miles away. Maintenance of this channel as a flood discharge channel was incorporated into the intracoastal canal project in 1937; however, this channel did not offer a definitive solution to the problems created by the Colorado River. When floods swelled the river, its flow still remained partially confined and the water level in the river would rise as much as 12 feet above mean low tide at its crossing with the canal. Because of this troublesome head differential, the Corps of Engineers concluded that lock structures at the Colorado River must become essential features of any plan to minimize delays to navigation on the waterway. Conversion of the floodgates into locks was undertaken early in the 1950s and completed by 1957.²²

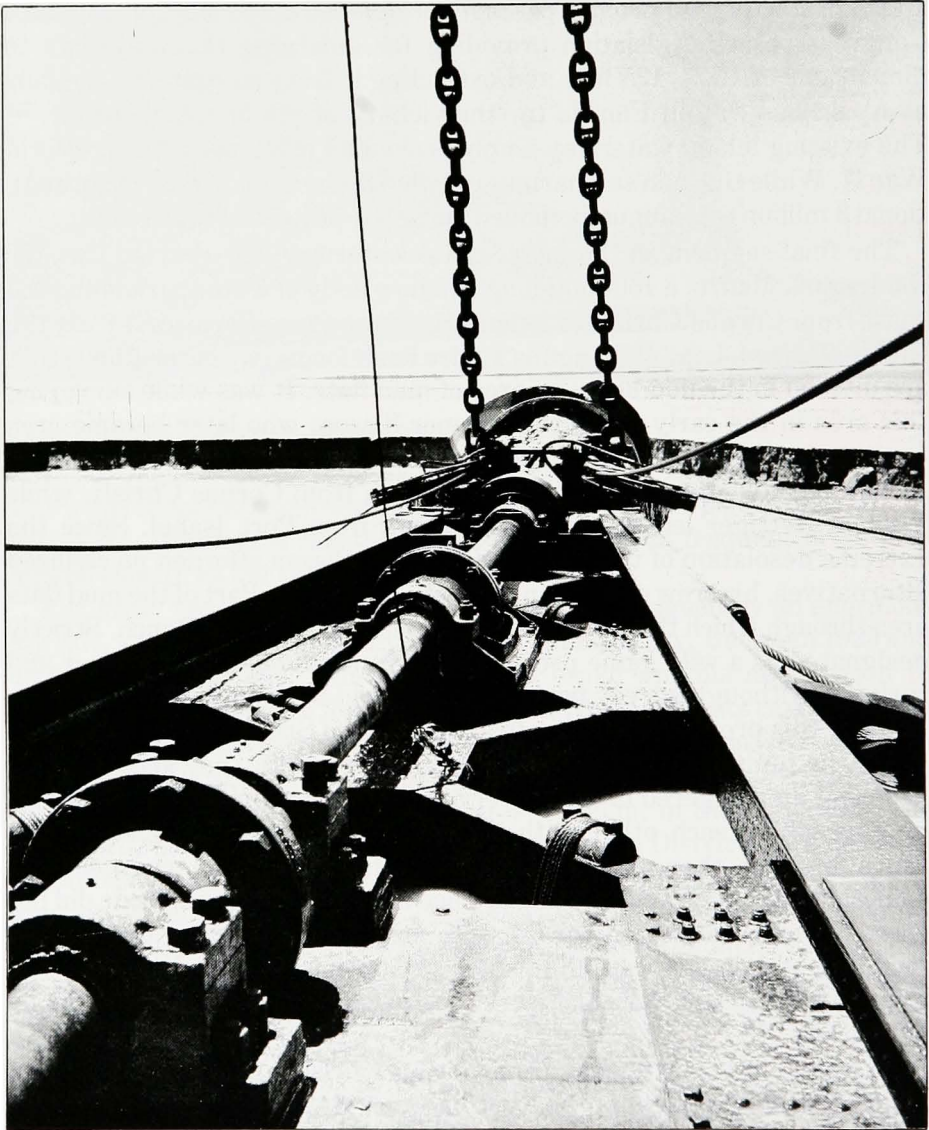
The Last Link

Exigencies of wartime hastened the next significant step in the growth of the intracoastal waterway. On July 23, 1942, motivated to promote national defense and recognizing the value of an inland system that would afford protected and prompt passage for defense materials and supplies, Congress passed legislation providing for enlarging the waterway to dimensions of 12 by 125 feet and extending it from its eastern terminus at Apalachee Bay in Florida to "the vicinity of the Mexican border."²³ The existing inland waterway amply proved its usefulness during World War II. While German submarines prowled in the Gulf of Mexico, an additional 3 million tons annually moved along the protected waterway.

The final segment in the intracoastal waterway was charted through the Laguna Madre, a 150-mile-long, shallow body of water paralleling the coast from Corpus Christi to Brazos Santiago Pass. Separated from the Gulf by Padre Island, the Laguna Madre itself forms two natural bays that are divided in the middle by an area of mud flats. It was while surveying this area in the early 1930s that Homer Sisson, who later became area engineer at Corpus Christi, acquired an unsought epithet.

Sisson conducted one survey party south from Corpus Christi, while William Rettiger led another party north from Port Isabel. Since the extreme desolation of the region assigned to Sisson afforded no civilized alternatives, his crew camped in tents along the way. Part of the mud flats area through which they worked passed along the Kenedy Ranch. Strictly designated as a wild game preserve, the ranch abounded with deer and turkeys. Although survey party members had been expressly forbidden to enter this property carrying firearms, two of Sisson's men apparently found the temptation irresistible. As the story goes, they shot two turkeys and then lingered in the preserve area to glory in their conquests by photographing each other with the spoils. Caught red-handed by the ranch foreman, they were brought before the local judge, charged with something like six counts each, and fined accordingly. The episode did not serve to further efforts by the Corps to secure rights of entry through the mud flats and, in fact, caused so much consternation in the district offices that Harry Sinclair, the chief clerk, bestowed upon Sisson the nickname of "Turkey."²⁴

Dredging of the extension from Corpus Christi to Port Isabel did not begin until enlargement of the existing waterway had been accomplished to Corpus Christi. Dredging operations began on December 12, 1945. Pipeline dredges started from both Corpus Christi and Port Isabel, working towards a meeting that would join the two sections of the Laguna Madre and mark the completion of an undertaking far more vast.



Dredging through mud flats of Laguna Madre. Cutterhead blades of dredge Miami break up the mud. This material is then sucked through a pipe and pumped to disposal area.



Completion of main channel connecting Mississippi River and Rio Grande. Dredge Miami, at left, moves south to meet dredge Caribbean, 1949.

At the remote mud flats, the McWilliams dredge *Caribbean* moved north to meet the Standard Dredging Corporation dredge *Miami*. The final cut was made and the channel was opened on the afternoon of June 18, 1949. Dignitaries and officials arrived by boat from Corpus Christi and Brownsville to attend ceremonies celebrating the historic occasion. A civic leader from Victoria had been given the official duty of executing the

traditional ribbon-cutting ritual. As this elderly gentleman struggled with the implement on hand, scissors that proved unequal to the task, Brownsville Area Engineer Thomas Forman whipped out his pocket knife and severed the ribbon, allowing the waiting tugboats to continue through with the first cargoes to travel the completed inland waterway to its Brownsville terminus.²⁵

Subsequent improvements along the waterway have involved various modifications and additional branch channels, bringing to twelve the total number of tributaries. Many of these, including channels to Harlingen, Port Mansfield, Aransas Pass, Rockport, and Palacios, were completed during the early 1950s. In 1952, a new lateral channel dredged to a point on the Guadalupe River near Victoria was incorporated into the waterway project.

The tributary channel at Port Mansfield, completed in 1949, preceded other interesting developments at that location. Situated 38 miles above Port Isabel on the lower part of the Laguna Madre, this isolated and obscure point was known as "Red Fish Landing" up until 1950. Around the middle 1950s, spurred by the determined efforts of a remarkable former county judge named Charles R. Johnson, Willacy County decided to give Port Mansfield an outlet to the Gulf by constructing a jetty-protected channel across Padre Island. Disregarding advice from engineers in the Galveston District, the local interests constructed their jetty by placing geometrically shaped, concrete blocks called tetrapods directly upon the sand bottom in the Gulf. The jetties were completed by September, and destroyed by storms in November of 1957. In 1959, Congress authorized the Corps of Engineers to take over construction of new parallel jetties and improvement of the channels and basins at Port Mansfield. This work was successfully completed in the 1962 fiscal year.²⁶

Prosperity at Port Mansfield (pop. 731) depends heavily upon commercial and sport fishing. Creation of the artificial inlet yielded benefits in addition to navigation. Opening of the pass and channel improved tidal exchange, reducing salinity in the bay and thereby enhancing the environment as a support to marine life. Resulting ecological changes in the adjacent bay area have nurtured more abundant populations of redfish, brown shrimp, flounder, and spotted trout, as well as other saltwater species.²⁷

Stretching from the west coast of Florida to the western extremity of the Texas Coast, the Gulf Intracoastal Waterway is referred to as the 1,000-mile miracle. Within Texas, the Galveston District maintains the 423 miles of main channel and 141 miles of tributary channels. Since this waterway opened in 1949, traffic has risen steadily and commerce has increased dramatically. Figures for tonnage handled by ports and moved



Port Mansfield jetties. Channel transects Padre Island.

on the Texas portion alone have soared as high as almost 69 million tons a year, a spectacular statistic in the light of the 12 million estimated by Goethals for the combined Texas-Louisiana system.²⁸

From Mudshell to Metal

As the Gulf Intracoastal Waterway tied together the many deep-draft ports along the Texas Coast, one more pass awaited improvement. Among the first to be used for navigation, Pass Cavallo at the entrance into Matagorda Bay was the last to be successfully improved. Nevertheless, it supported considerable traffic long before establishment of the Galveston District.

The French explorer René-Robert Cavelier, sieur de La Salle, landed on the western shore of Matagorda Bay near Indianola around the year 1685. He had set sail for the mouth of the Mississippi, intending to settle and build fortifications there, but his miscalculations overshot his proposed destination by 500 miles. He claimed the land in the name of France, but continued his futile search for the Mississippi until his death a couple of years later.

The first survey at Matagorda was reported early in 1853 by Lt. George B. McClellan, who stated that, although Pass Cavallo had the best bar after Galveston,

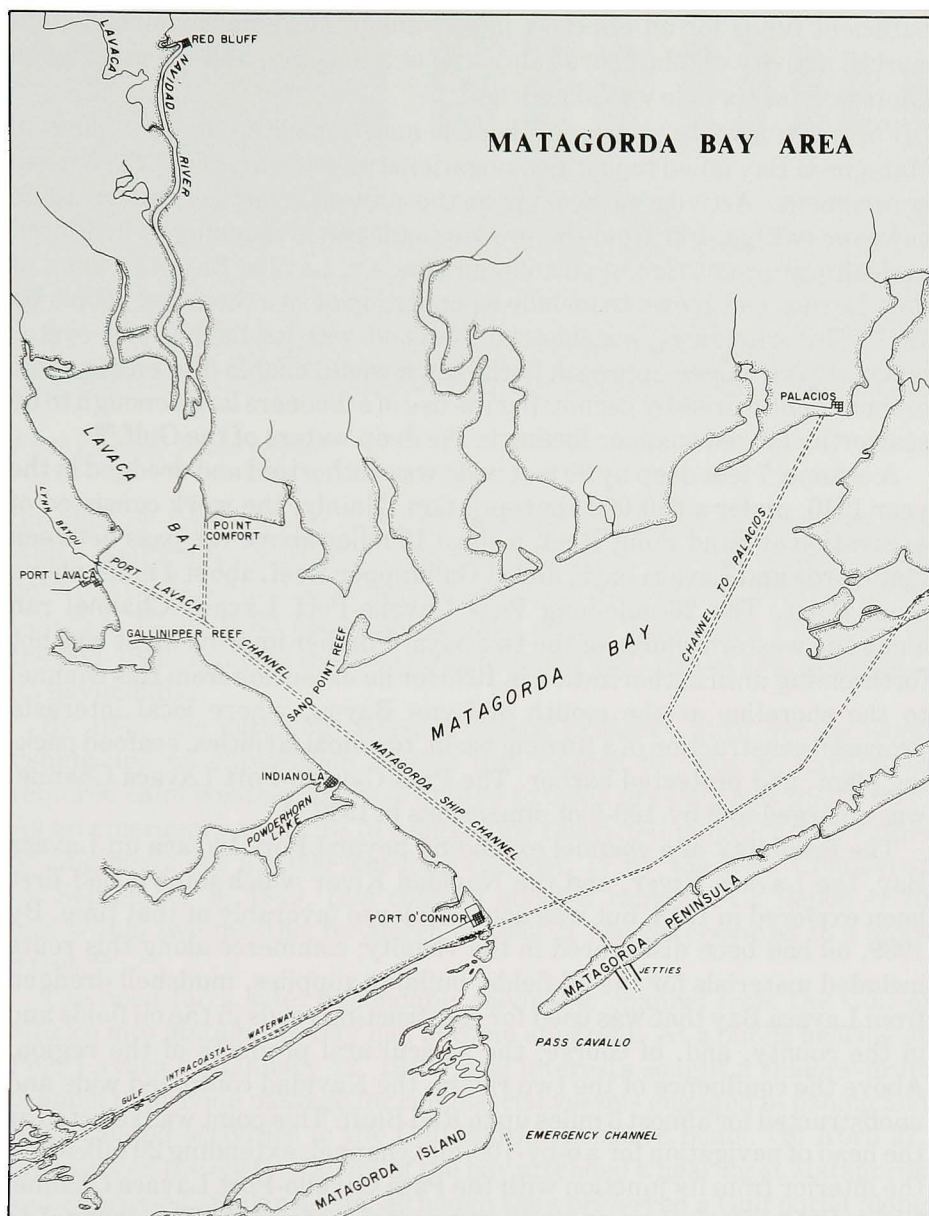
Were anything attempted . . . it would involve the revetement [sic] of about four miles of shore and the construction of more than five miles of dike.

Emphasizing his lack of enthusiasm for improvement at this pass, he declared:

As far as regards the "twenty-foot" channel expected to be obtained, one of one hundred feet might be looked for with equal confidence.²⁹

During the mid-nineteenth century, the harbor at Indianola flourished, welcoming Morgan Line steamers and other vessels; by 1870, the town had a population of 1,900. The awful storm of 1875 submerged and swept away the town, with great loss of life. In 1880, Indianola had only 931 residents.³⁰

Unaware that a second storm in 1886 would irrevocably complete the destruction of the once thriving port at Indianola, a board of engineers proposed a plan for improvement at the pass in 1879. To secure a 12-foot channel depth across the bar, a single jetty was begun by Major Mansfield in 1881 at the south side of the pass, designed to extend 7,600 feet from Matagorda Island. Construction proceeded over the next five years, marked by the usual problems of inadequate funds and work suspensions; despite Mansfield's sanguine appraisals of the jetty's effect, in 1887 after



Major Ernst had taken over the reins of the district and surveyed the jetty, he pronounced it a failure, adding,

The improvement of this entrance is the most uncertain and difficult undertaking that has been projected upon the Texas coast.³¹

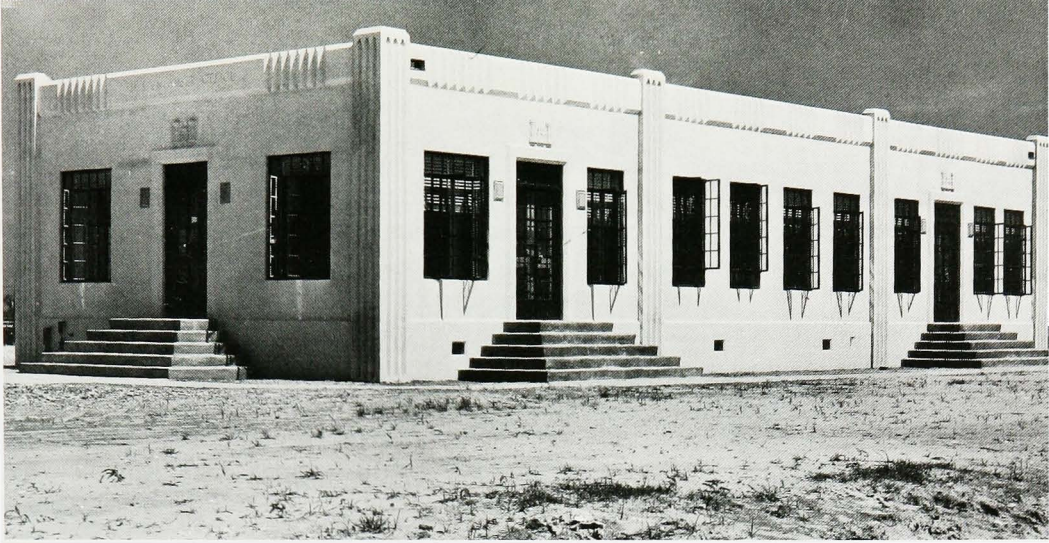
Sufficient funds for an effective improvement were not available, commercial activity on Matagorda Bay was at a low ebb, and the attempt to improve Pass Cavallo was abandoned.

For about twenty years, settlement and commerce on the shores of Matagorda Bay failed to justify navigational improvements by the federal government. Activity picked up in the adjacent territory after 1905, however, with a shift from the predominant cattle ranching to increased agricultural production of cotton and rice. On Lavaca Bay, the town of Port Lavaca had grown to include a population of two thousand people by 1908. This community's industrial lifeblood was its fishing and oyster business. A dredged approach to the town would enable it to enlarge this economic enterprise by permitting the use of schooners large enough to be seaworthy for red snapper fishing in the deep waters of the Gulf.³²

A channel 7 feet deep by 80 feet wide was authorized and dredged in the year 1910, under a \$10,000 appropriation. Mainly, the work consisted of excavation at Sand Point Reef, a shoal 18 miles above the pass between Matagorda and Lavaca bays, and at Gallinipper Reef, about 4 miles above Sand Point. The 26-mile-long Pass Cavallo-Port Lavaca Channel ran along the western shores of the two bays. Further improvement was not forthcoming until authorization in 1935 for an extension from this channel to the shoreline at the mouth of Lynn Bayou, where local interests proposed construction of a turning basin, terminal facilities, seafood packing plant, and protected harbor. The Pass Cavallo-Port Lavaca Channel was enlarged to 9-by-100-foot dimensions in 1939.³³

The feasibility of a channel extending beyond Port Lavaca up Lavaca Bay, the Lavaca River, and the Navidad River which joins it had first been explored in 1913, but was not considered favorably at that time. By 1939, oil had been discovered in the vicinity; commerce along this route included materials for the oil fields, building supplies, mudshell dredged from Lavaca Bay that was used for constructing roads in the oil fields and in the county, and, of course, the agricultural products of the region. Above the confluence of the two rivers, the Navidad continued wide and unobstructed for almost 3 miles up to Red Bluff. This point was selected as the head of navigation for a 6-by-100-foot channel, extending 20 miles into the interior from its junction with the Pass Cavallo-Port Lavaca Channel which linked it to the growing intracoastal waterway. The channel to Red Bluff was authorized in 1945 and completed in 1957; a 9-foot-deep approach channel and harbor of refuge below Port Lavaca, authorized at the same time, were completed during 1959-60.³⁴

After abandonment of the jetty project at Pass Cavallo in 1888, no improvement had been attempted between the Gulf and Matagorda Bay. For many years, Pass Cavallo served in its natural state to accommodate



Port Lavaca Field Office

the shallow-draft vessels using its channel. The pass had remained in a stable position for more than two hundred years and the channel depth between the inner and outer bars ranged from 20 to 42 feet. Opening of the Colorado River flood discharge channel across Matagorda Peninsula in the mid-1930s reduced the tidal flow through Pass Cavallo and, gradually, its navigability.

By 1949, the outer bar posed a drastic problem, even for the small fishing and oil exploration vessels that needed to cross it; navigation required calm weather and was limited to boats drawing less than 6 feet. As an emergency measure to relieve this restricted situation, the Corps of Engineers cut a 3,000-foot-long channel, 17 by 135 feet. Completed by September 9, 1949, this channel shoaled rapidly to a depth of 10 feet within two months; by March of 1952, it had deteriorated to a mere 8 feet.³⁵

The need for a safe, dependably navigable channel from the Gulf of Mexico into Matagorda Bay had become apparent. At a public hearing at Port Lavaca on January 12, 1949, local interests sought a shallow-draft channel to provide passage for commercial vessels engaged in fishing and in oil-related activities in the Gulf and for pleasure boats. On April 27, interests on the eastern shore of the bay attended a hearing at Matagorda and expressed similar needs, although they preferred a Gulf outlet along the route of the Colorado River.³⁶

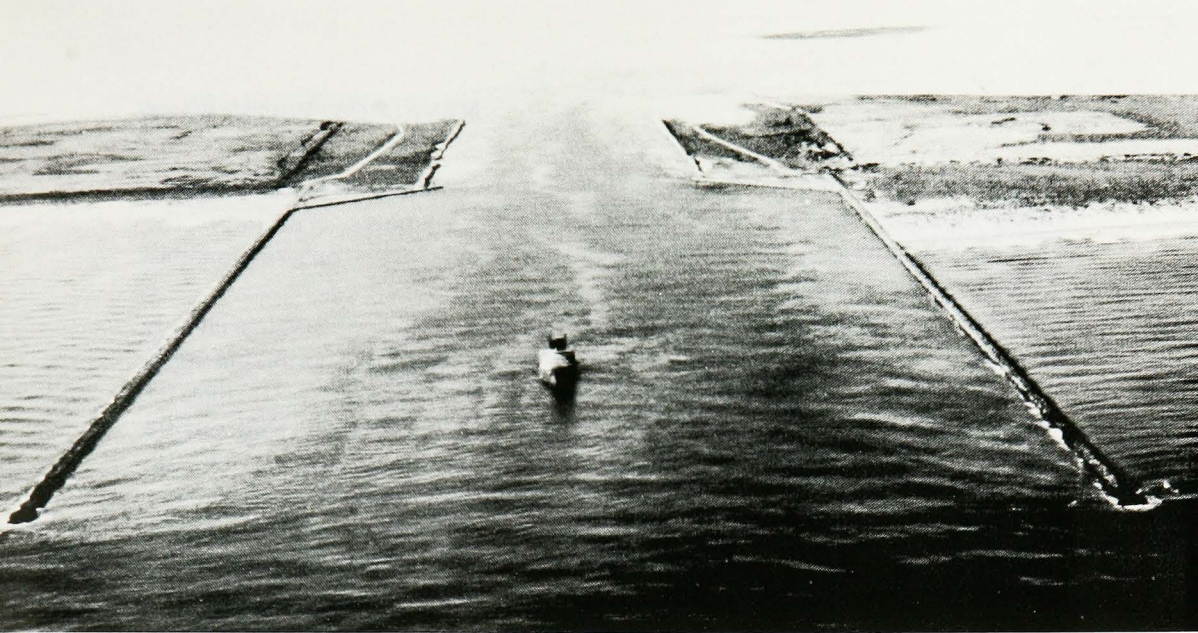
Late in May, 1955, the desirability of a deep-draft channel arose; this was requested by the Calhoun County Navigation District at a hearing in Palacios on August 2. The proposed channel would terminate at a turning basin at Point Comfort, where the Aluminum Corporation of America had constructed an aluminum smelting plant to which it had dredged a 9-by-100-foot channel from the Pass Cavallo-Port Lavaca Channel in 1949.

Alcoa's plans to erect two alumina reduction plants entailed importing 1,080,000 tons of bauxite ore annually from Surinam, South America and from the Dominican Republic. At that time, ore was being brought in through Aransas Pass, transferred to barges, and transported approximately 75 miles along the intracoastal waterway — a cumbersome and expensive operation. A deep-draft channel would permit new ore carriers, with loaded drafts of 34 feet, to bring the bauxite directly to Point Comfort. In requesting deep-draft improvements, the company entered into a franchise agreement with the Calhoun County Navigation District for certain areas and services, including a public dock. The turning basin at Point Comfort was to be designated the Calhoun County Turning Basin, served by the public dock on which Alcoa proposed to furnish \$4 million worth of handling facilities and rail connections.³⁷

In 1958, Congress authorized the first deep-draft project for Matagorda Bay.³⁸ Called the Matagorda Ship Channel, the project extended from the Gulf to Point Comfort and included a 4-mile-long, 38-by-300-foot outer bar and jetty channel, a 22-mile-long, 36-by-200 foot inner channel (incorporating the existing Pass Cavallo-Port Lavaca Channel), a 1,000-foot-square turning basin at Point Comfort, and dual jetties to protect the entrance channel from wave action and shoaling. The act also provided for enlargement of the shallow-draft channels near Port Lavaca.

Between 1959 and 1962, the U.S. Army Engineer Waterways Experiment Station at Vicksburg constructed a model and conducted investigations primarily to determine the best location for the entrance channel and the type of protective works that would be needed to secure and maintain the channel. Three entrance plans were studied: one through Pass Cavallo and two involving cuts across Matagorda Peninsula, northeast of the natural pass. The location selected lay about 5 miles from the pass and afforded the shortest and straightest route. It further involved less extensive jetties than would be needed at Pass Cavallo, with correspondingly lower construction and maintenance expenses.³⁹

During the course of construction, one "happenstance" caused a deviation from the original timetable. Contractors were scheduled to begin dredging the cut across the peninsula on the bay side and work toward the Gulf; they were not to complete the cut, however, until the work on the jetties was finished. They dredged as far as they could and then stopped, awaiting completion of the jetties. Once again, the erratic weather of the Gulf Coast intervened. A severe storm blew in; when it blew out, a prematurely completed cut lay in its wake. Consequently, the final stages of jetty construction were attended by some uninvited difficulties, but these complications were eventually overcome and the deep-draft Matagorda Ship Channel was opened to traffic in 1966.⁴⁰



U.S. hopper dredge McFarland sails through Matagorda Ship Channel jetties.

The Work Goes On

Since the army engineers first surveyed the Texas Coast in 1852, this region has grown into an important sector of the national economy. Raw materials moved along the intracoastal waterway feed into the many waterside plants and refineries that have sprung up along its banks. Major waterway users — petroleum, chemical, and non-metallic minerals companies — are joined by the host of other coastal industries that enjoy the economies of transportation by water. The channel improvements accomplished by the Galveston District have catalyzed transformation of this locale into a thriving industrial, residential, and recreational complex. Commerce along the waterways accounts for more than three-fourths of all goods shipped out of the state. In the year 1974, Texas ports handled cargoes exceeding 241 million tons.

Oldest responsibility of the Galveston District, coastal navigation has been continuously facilitated by the district since its establishment. The works described in this history reflect only the highlights of the district's accomplishments in this sphere of civil works. The scope of surveys undertaken and improvements made is far too extensive to allow for inclusive coverage. It would be doing the district an injustice, however, to fail to mention that many other navigation projects have been executed.

Despite boundary changes that have occurred, the Galveston District has retained its responsibility for navigation. In 1933, the district was relieved of responsibility for the Red River watershed, keeping within its

jurisdiction all other river and harbor improvements in Texas. Significantly affecting the Galveston District in other respects, creation of the Fort Worth District in 1950 left substantially intact Galveston's responsibility for coastal navigation.

Although the major thrust of new construction along the coast has largely subsided, the work goes on. A channel 40 feet deep offers no navigational advantage unless it can be relied upon to indeed be 40 feet deep. The district attends to the task of maintaining dependable project depths that enable ships to safely sail the channels within its boundaries. Further, it keeps the channels clear of obstructions and enlarges them to meet the demands of larger vessels being placed in service. Constant surveillance and rehabilitation are required for the protective jetties that receive endless abuse from the ravages of Gulf currents, tropical storms, and whatever other insults the elements and civilization may heap upon them. Finally, the district has protected its navigable waters from harmful alterations and detrimental refuse, exercising this regulatory function more vigorously in recent years.

The Galveston District has been said to have more boats in operation along its coast than does the Coast Guard.⁴¹ In all, 260 miles of deep-draft and 720 miles of shallow-draft channels comprise the "housekeeping" work of the district — unglamorous, perhaps, but nevertheless essential to securing the Texas Coast for the purposes of navigation.

Notes to Chapter 6

¹ Act of March 3, 1826, *Laws of the United States Relating to the Improvement of Rivers and Harbors from August 11, 1790 to June 29, 1938* (Washington, D.C.: Government Printing Office, 1940), 1: 30-31; As early as 1818, George Graham, and American emissary sent to Texas, envisioned the navigational potential of a coastal canal behind the chain of islands running southwest of Galveston. Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), pp. 13-15.

² Rivers and Harbors Act of March 3, 1873, ch. 233, 17 Stat. 560.

³ *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1875* (Washington, D.C.: Government Printing Office, 1875), pp. 876, 896 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).

⁴ *Ibid.*, p. 876.

⁵ *Ibid.*, pp. 898-99.

⁶ *Ibid.*, p. 877.

⁷ Rivers and Harbors Act of July 13, 1892, ch. 158, 27 Stat. 88; *ARCE*, 1896, p. 1544.

⁸ *ARCE*, 1888, p. 1298; *ARCE*, 1897, p. 1810; *ARCE*, 1900, p. 2422; Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331.

⁹ H.R. Doc. 640, 59th Cong., 2d sess. (1907), p. 49.

¹⁰ Tom Lea, *The King Ranch* (Boston: Little, Brown & Co., 1957), p. 548.

¹¹ Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117; H.R. Doc. 640, 59th Cong., 2d sess. (1907), pp. 3-4.

¹² H.R. Doc. 640, 59th Cong., 2d sess. (1907), pp. 4-5, 23; Rivers and Harbors Act of March 2, 1907, ch. 2509, 34 Stat. 1073; *ARCE*, 1909, p. 1510; *ARCE*, 1910, pp. 549-50.

¹³ William J. Hull and Robert W. Hull, *The Origin and Development of the Waterways Policy of the United States* (Washington, D.C.: National Waterways Conference, Inc., 1967), p. 31.

¹⁴ H.R. Comm. Doc. 3, 61st Cong., 2d sess. (1908), p. 5.

¹⁵ Rivers and Harbors Act of June 25, 1910, ch. 382, 36 Stat. 630; Rivers and Harbors Act of March 3, 1909, ch. 264, 35 Stat. 815.

¹⁶ Hearings before Committee on Rivers and Harbors, House of Representatives, 77th Cong., 1st sess., on The Improvement of the Louisiana and Texas Intracoastal Waterway from Corpus Christi, Tex. to the Rio Grande, October 7, 1941, from testimony of C.S.E. Holland, p. 7; H.R. Doc. 238, 68th Cong., 1st sess. (1924), p. 98.

¹⁷ H.R. Doc. 238, 68th Cong., 1st sess. (1924), pp. 2-6, 40-47; Rivers and Harbors Act of March 3, 1925, ch. 467, 43 Stat. 1186; Rivers and Harbors Act of January 21, 1927, ch. 47, 44 Stat. 1010.

¹⁸ H.R. Doc. 238, 68th Cong., 1st sess. (1924), p. 45.

¹⁹ *ARCE*, 1942, p. 865.

²⁰ H.R. Doc. 230, 76th Cong., 1st sess. (1939), p. 14.

²¹ *Review of Reports on the Gulf Intracoastal Waterway at the Brazos River and the Colorado River Crossings, Texas* (Unsubmitted report, Corps of Engineers, Galveston District, October 1949), p. 29 (hereafter cited as *Review of Reports*); *ARCE*, 1944, p. 762; *ARCE*, 1945, p. 1029.

²² H.R. Doc. 642, 75th Cong., 3d sess. (1938), pp. 7-8; S. Doc. 102, 90th Cong., 2d sess. (1968), p. 26; H.R. Doc. 388, 84th Cong., 2d sess. (1956), p. 18; *Review of Reports*, pp. 7, 30; *ARCE*, 1957, p. 701.

²³ Act of July 23, 1942, ch. 520, 56 Stat. 703.

²⁴ Interview with William C. Rettiger, 25 February 1975.

²⁵ Interview with Thomas Forman, 12 June 1974.

²⁶. *ARCE*, 1952, p. 919; S. Doc. 11, 86th Cong., 1st sess. (1959), pp. 3-4, 12-13; Act of September 9, 1959, Pub. L. No. 86-248, §4, 73 Stat. 478; *ARCE*, 1962, p. 751.

²⁷. Joseph P. Breuer, "An Ecological Survey of the Lower Laguna Madre of Texas, 1953-1959," *Publications of the Institute of Marine Science* 8 (1962): 162, 180. Breuer also notes on p. 179, "Since the dredging of the Intracoastal Canal in 1948, fish kills due to hypersalinity have not occurred."

²⁸. H.R. Doc. 238, 68th Cong., 1st sess. (1924), p. 102; Recent legislation introduced by State Sen. A. R. Schwartz of Galveston and Rep. Pike Powers of Beaumont resulted in the Texas Coastal Waterway Act of 1975. Effective 1 September 1975, this law authorized the state to serve as local sponsor for the main channel of the waterway by acquiring easements and rights-of-way for deposit of dredged material and for channel expansion, relocation, or alteration in areas not incorporated by port and navigation districts. TEX. REV. CIV. STAT. ANN. art. 5415e-2, §1-7 (Supp. 1975).

²⁹. S. Ex. Doc. 1, 33d Cong., 1st sess. (1853-54), 2: 562.

³⁰. *ARCE*, 1888, p. 1305.

³¹. *Ibid.*

³². H.R. Doc. 1082, 60th Cong., 2d sess. (1908), pp. 3-6.

³³. Rivers and Harbors Act of June 25, 1910, ch. 382, 36 Stat. 630; *ARCE*, 1911, p. 1800; H.R. Comm. Doc. 28, 74th Cong., 1st sess. (1935), p. 2; Rivers and Harbors Act of August 30, 1935, ch. 831, 49 Stat. 1028; Rivers and Harbors Act of August 26, 1937, ch. 832, 50 Stat. 844; *ARCE*, 1939, pp. 953-54.

³⁴. H.R. Doc. 1667, 63d Cong., 3d sess. (1915), p. 2; H.R. Doc. 314, 76th Cong., 1st sess. (1939), pp. 2, 8-10; Rivers and Harbors Act of March 2, 1945, ch. 19, 59 Stat. 10; *ARCE*, 1960, p. 693; *ARCE*, 1961, p. 765.

³⁵. H.R. Doc. 388, 84th Cong., 2d sess. (1956), pp. 12, 18.

³⁶. *Ibid.*, p. 20.

³⁷. *Ibid.*, p. 19.

³⁸. Rivers and Harbors Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 297.

³⁹. H. D. Simmons and H. J. Rhodes, *Matagorda Ship Channel Model Study, Matagorda Bay, Texas*, Technical Report no. 2-711 (Vicksburg: U.S. Army Engineers Waterway Experiment Station, 1966), p. 32.

⁴⁰. S. Doc. 99, 90th Cong., 2d sess. (1967), p. 65.

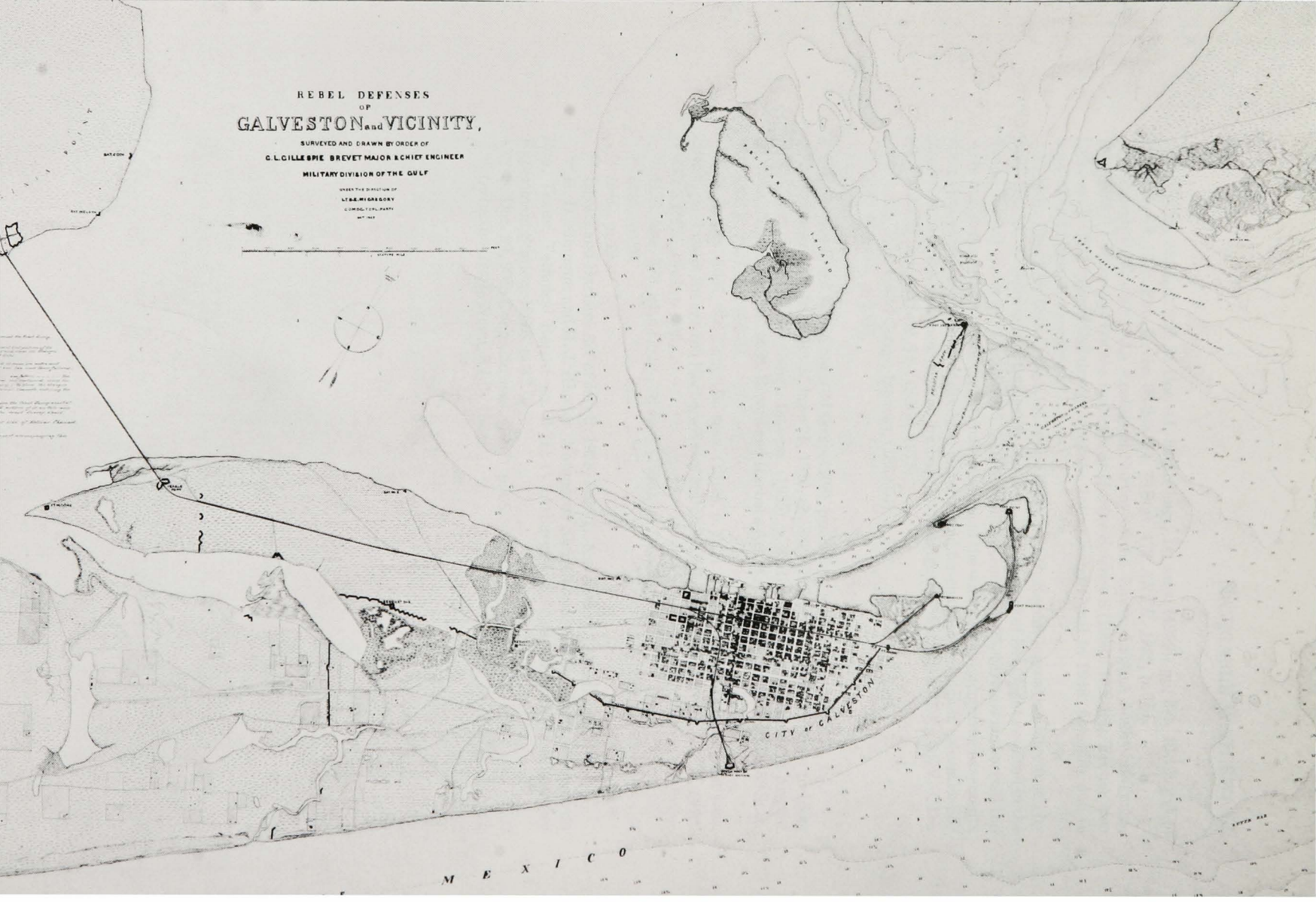
⁴¹. *Galveston Daily News*, 3 July 1974.

REBEL DEFENSES
OF
GALVESTON and VICINITY,

SURVEYED AND DRAWN BY ORDER OF
C. L. GILLESPIE, BREVET MAJOR & CHIEF ENGINEER
MILITARY DIVISION OF THE GULF

UNDER THE DIRECTION OF
LT. & M. GREGORY
COMB. TOP. PARTY
SEP. 1862

SCALE OF FEET



The Military Mission

Implicit in the very being of the Corps of Engineers is its military mission. Initially a by-product of the nation's earliest wartime struggles, the Corps has served in a dual capacity for many years. The civil works function continuously discharged by Corps personnel has insured the existence of a contingent of trained engineers who are prepared to make the transition to military duties when the need arises. The flexibility required to abruptly shift gears and move swiftly from civil into military construction underlies this organization's history.

The Harbor Defenses of Galveston

One of the principal tasks undertaken by the first West Point engineer officers was construction of seacoast fortifications. Many decades passed, however, before their efforts reached the Texas Gulf Coast. Meanwhile, scattered defensive measures to protect the strategic harbor at Galveston were begun as early as 1816 under Spanish rule and continued through the succeeding regimes of Mexico and the Texas Republic. The military, economic, and political importance of the port was evidenced by a \$300,000 appropriation by Congress in 1856 to erect fortifications in the bay.¹

During the Civil War, Confederate authorities protected Galveston with an extensive system of at least eighteen temporary installations ranging from modest earthworks to more pretentious structures. Designed chiefly to oppose a landing in force, these fortifications were located on the island itself, Bolivar Point, Pelican Spit, and on the mainland at Virginia Point. After the close of hostilities, future Chief of Engineers Brevet Maj. (later Maj. Gen.) G. L. Gillespie surveyed these defenses and filed his map in the Engineer Bureau of the War Department.²

Opposite page: Major Gillespie's map of rebel defenses shows South Battery along Galveston beachfront. Fort Scurry is located at eastern extremity of city, followed by Fort Bankhead, Fort Magruder, and Fort Point. Dark line running south of city indicates line of defensive works. (National Archives)

As army engineers began earnestly surveying Texas harbors, Lt. W. S. Stanton described the vestiges of defensive works at Fort Point:

. . . During the storm of October last [1867], . . . the northern part of the east shore of the island receded about 130 feet; the wharf and all the buildings, three in number, and the casemated defensive work situated at the northeast corner of the island, were entirely demolished and all their material swept away by the sea. The 42-pounder and the two 32-pounders which formed the armament of the work are now scarcely visible above the surface of the water. A barbette battery formed of sand, and containing one unserviceable 9-inch naval gun, is the only work remaining on the island.

He mentioned Pelican Spit as a potential site for a permanent work if it were protected by breakwaters.³

On February 23, 1876, Chief of Engineers Gen. A. A. Humphreys called upon a board of engineers to plan defenses for Galveston. The growing importance of the port and the desirability of furnishing defenses for Galveston Harbor were becoming obvious. First in 1880, and again in the subsequent years, the sum of \$50,000 was requested for "earthen batteries of heavy guns . . . to be placed on Pelican Spit, Galveston Island, and Bolivar Point . . ." ⁴ The appropriation was never made.

In fact, the problem was considerably more widespread. The coasts of the United States stood largely undefended; those old-style masonry forts that remained were mounted with obsolete ordnance, incapable of coping with the more modern, armored ships that had been introduced. Growing concern over adequate coastal defense prompted the president, under an act dated March 3, 1885, to appoint a Board on Fortifications and Other Defenses. Popularly known as the Endicott Board, this body published a report in 1886 which gave rise to a new system of seacoast defenses including manufacture of up-to-date ordnance, construction of gun and mortar batteries, and torpedo defenses. The original plans provided for twenty-seven principal ports among which Galveston ranked seventeenth in order of urgency. Manufacture of modern ordnance, the highest priority, began under an appropriation act approved September 22, 1888. The first appropriation for construction of batteries was made in an act passed August 18, 1890. The board of engineers visited Galveston and examined sites in April of 1895, returning to New York to prepare plans for both artillery and submarine mining defenses.⁵

Galveston Engineer Office personnel added military work to their civil responsibilities for the first time in 1895. Maj. A. M. Miller and Lt. W. V.

Judson turned their attention to the initial fortification work, a mining casemate for torpedo defense, begun with an allotment of \$10,000. This meager allowance demanded such stringent economy that purchase of any mixing plant was out of the question and the concrete had to be made by hand. By June 30, 1897, this casemate had been completed at Fort Point, built at a cost of \$15,009.27. Meanwhile, work was begun on gun and mortar emplacements. On January 12, 1897, an allotment of \$71,000 was made for the purchase of fortification sites. One site was purchased at a price of \$35,000 and negotiations for a second, costing \$36,000, were in progress.⁶

As diplomatic relations with Spain assumed an ominous aspect, national defense was accorded higher priority; orders were issued to push work ahead and mount every available gun with the greatest possible haste. Additional gun emplacements were authorized for Galveston under new national defense appropriations. Capt. Charles S. Riché, then in charge at Galveston, received reinforcements of additional army officers. Lt. Harry Burgess, who had just completed a torpedo course at Willets Point, was ordered to Galveston early in April, 1898. On April 25, Congress declared war against Spain, making the declaration retroactive to April 21.⁷

Lieutenant Burgess directed installation of submarine mining defenses in Galveston Harbor. On April 23, 1898, he laid the cable and began placing mines in the entrance channel and in the Gulf along the beach-front. Burgess was unable to secure a suitable boat for this operation, so the work was accomplished by a makeshift arrangement with the government tug *Anna* towing a derrick barge hired for the purpose. Since the turbulent winds and choppy waters of the Gulf did not discriminate between military and civil undertakings, the motor power of the tug often proved insufficient to handle the barge, thereby delaying the work. The mines were connected by cable to the operating apparatus housed in the shotproof casemate. During the time the harbor was obstructed by mine fields (until August 22, 1898), Galveston Engineer Office personnel patrolled the mines daily, testing them, repairing defects, keeping batteries and operating devices in order, and holding the system ready for immediate service. In July, 1898, they added searchlight facilities to the harbor defenses.⁸

Meanwhile, work continued on the batteries around which grew the three major installations that would safeguard Galveston Island and its harbor over the next fifty years. Situated on a large tract at the east end of the island and named for the deciding battle in the Texas War of Independence, Fort San Jacinto was the first to be garrisoned (on April 20, 1898). This government reservation had been set aside for public purposes by an act of the Republic of Texas dated December 9, 1836 and under joint

SUBJECT: Mining Defense.

Office of the Chief of Engineers,
United States Army,

Washington, April 19, 1898.

1st Lieut. C. L. Riche
Corps of Eng. U.S.A.
Galveston Texas

Sir:

It is desired that you shall at once complete every detail of the mining defense of the harbors under your charge, so far as available materials will admit, except placing the mines in position, and that upon receipt of a telegram from me to "go ahead with mines", you will place the mines in position and complete everything necessary for operating them, as rapidly as possible.

Upon receipt of this letter you are requested to report how soon after the receipt of a telegram the mining defenses under your charge will be ready for service.

Very respectfully,

John M. Wilson
Brig. Gen., Chief of Engineers,

U. S. Army.

Burgess.

Hold up on the mines
Didn't you understand preceding
letter to mean "put 'em in"?
C.S.R.

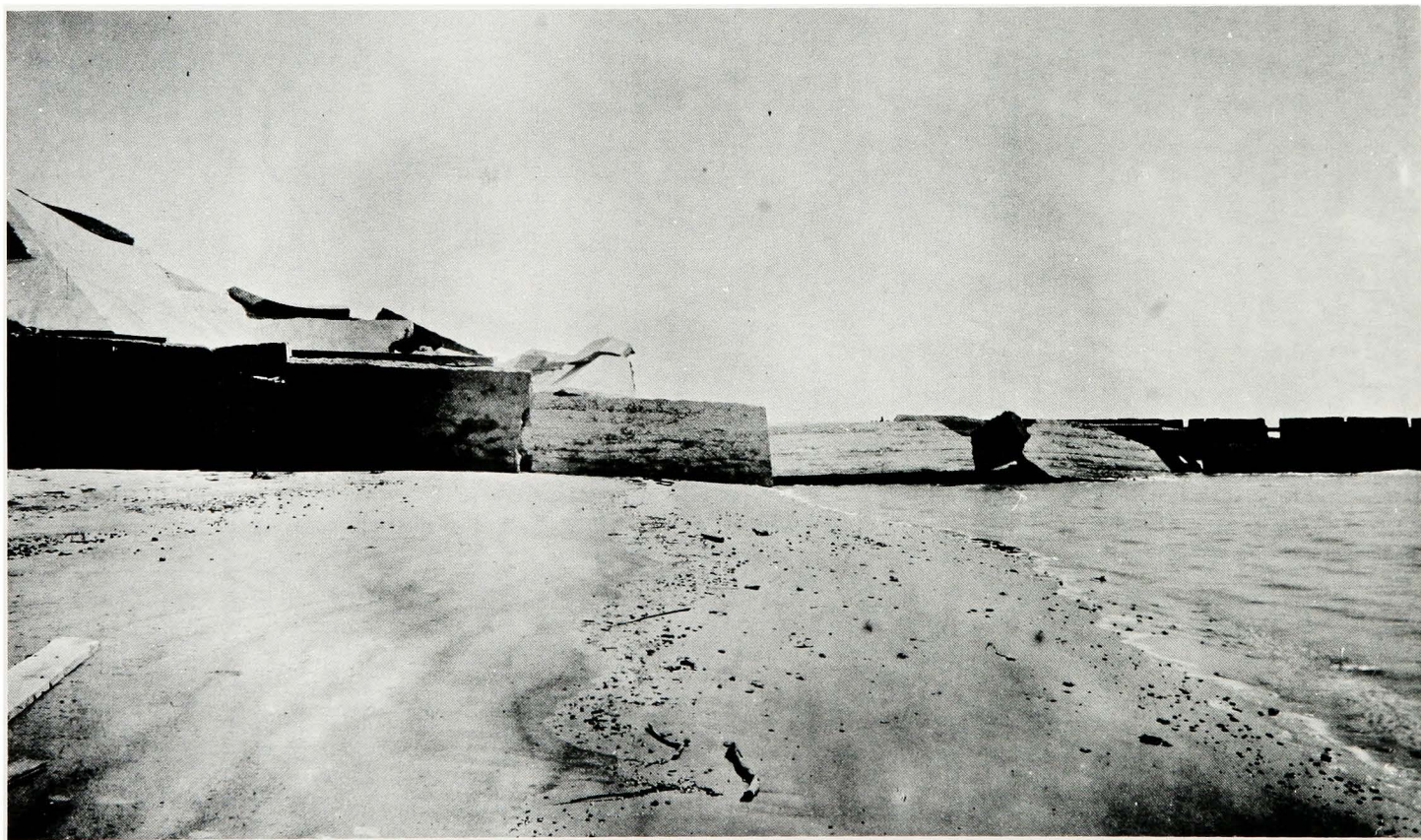
resolution of Congress about the time of annexation. Earlier fortifications in this vicinity had been a Fort Travis, built in 1836, and the later Fort Point and Fort Magruder, of Civil War vintage. The new Fort San Jacinto contained four original batteries, one mining casemate, submarine mining warehouses, cable tanks, and tracks for communication.⁹

As protection for the city, batteries were begun in 1897 along the city beachfront. On January 18, 1897, the United States had purchased for \$35,000 approximately 125 acres (bounded by Forty-fifth Street, Avenue U, Forty-ninth Street, and Avenue W along the waterfront) from the Galveston Land and Improvement Company, a Colorado corporation based in Denver. Through a second transaction on April 17, 1900, the federal government paid the heftier sum of \$126,000 to acquire the adjacent parcel of land from Forty-ninth Street to Fifty-third Street. This property, between Forty-fifth and Fifty-third streets, was named the Fort Crockett Military Reservation in honor of David Crockett, hero of the Alamo. First garrisoned in April, 1899, Fort Crockett contained three original batteries. The third installation, Fort Travis, was located on Bolivar Point, across the channel from Galveston Island. Boasting two batteries, Fort Travis was turned over to the Coast Artillery on October 25, 1899.¹⁰

In September of 1900, the terrible storm struck the island that all but obliterated the city of Galveston. As might be expected from their exposed locations along the Gulf, the government fortifications fared little better than the rest of the city. Batteries previously completed and garrisoned were transferred back to the charge of the Engineer Department.¹¹

Col. Henry M. Robert, Maj. H. M. Adams, Captain Riché, and Capt. Edgar Jadwin were appointed to assess the damage. This board met in Galveston from October 22-27, examined the condition of the jetties, the main ship channel, and the fortifications, and decided upon general lines of needed repairs. Drawings and computations were prepared in Galveston under Riché's direction. The officers found the batteries not constructed upon pile foundations damaged beyond repair. Their plan for replacement of those batteries and repair of the others was provided for by a \$992,000 appropriation under an act passed March 1, 1901.¹²

The work of reconstruction and repair was completed by 1906. In 1911, the batteries reverted to the Coast Artillery under command of the coast defense commander at Fort Crockett. This fort quickly gained prominence as a mobilization center for troops to serve at the Mexican border.

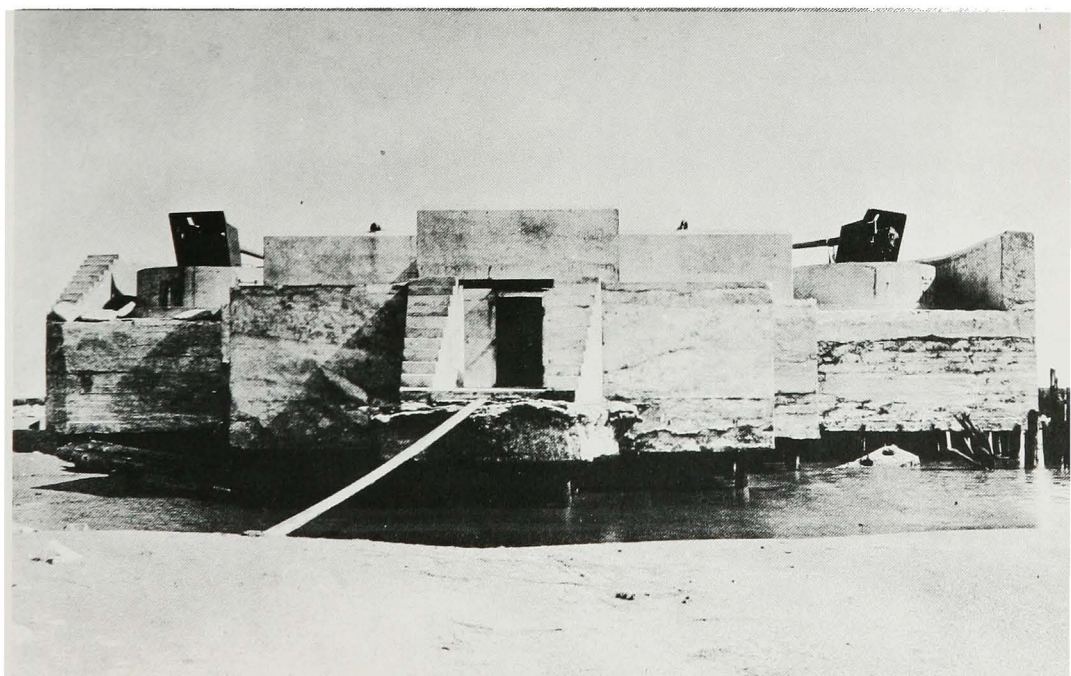


Battery Mercer at Fort San Jacinto, viewed from southwest on September 20, 1900, offers a study in surrealism.



Magazine of Battery Mercer after storm, September 20, 1900

Effects of 1900 storm on Battery Hogan, September 21, 1900





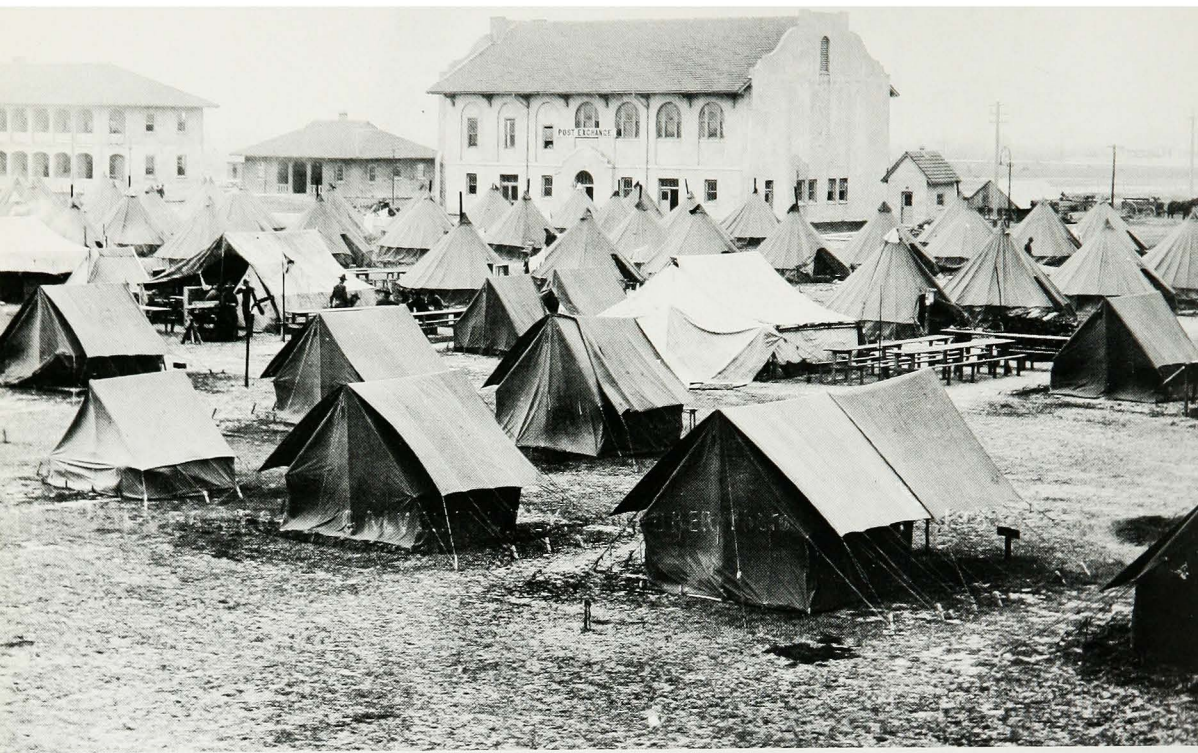
Destruction from storm at Fort San Jacinto's Battery Heileman resembles aftermath of war.



Construction of gun well for 12-inch battery at Fort Crockett, 1918

During World War I, heavy artillery troops for the expeditionary forces received training at Fort Crockett. Trench mortar units, railroad artillery and howitzer organizations, and a steady stream of replacement batteries left the fort for duty overseas. In addition, replacement troops were shipped to France at frequent intervals, toward the latter part of the conflict at a monthly rate of between one hundred and two hundred men. As many as three thousand men are estimated to have been at Fort Crockett at one time during the war.¹³

Galveston army engineers built two new batteries about this time. Battery Hoskins at Fort Crockett was begun in August, 1917 and was turned over to the coast defense commander on May 16, 1921. Cost of the battery ran approximately \$300,000 with an additional \$150,000 for guns and carriage. One year later, Battery Kimble was completed at Fort Travis.¹⁴



Temporary housing at Fort Crockett (Rosenberg Library)

An Unprecedented Challenge

Prior to World War II, the predominant military responsibility of the army engineers had consisted of building fortifications, roads, and bridges, plus other combat-related activities. Although these duties were traditionally assigned to the Corps of Engineers, the function of sheltering troops resided in the Quartermaster Corps. Still other, smaller segments of military construction were performed by the Ordnance Department and the Signal Corps.¹⁵ World War II would change all this.

World War I had offered a taste of what was to come. It had caught the United States completely unprepared for large-scale warfare, setting off a frantic and costly emergency construction program to meet the sudden need for cantonments. But the lessons of World War I went largely unheeded and appropriate steps to avoid future unpreparedness were not carried through. Although the news from Europe in the late 1930s pointed in the direction of another war, mobilization efforts in the United States moved slowly at first.

As the months passed, the country moved toward the brink of war. Once again, the nation was compelled to seriously address itself to the realities of a major military encounter. The unprecedented magnitude of

World War II and technological advances in modern warfare presented a tremendous challenge in military construction. Before an army could be assembled and trained, a vast assortment of reception centers, training camps, and cantonments was essential.

Appropriations were gradually forthcoming as the urgency for construction approached critical proportions. Confronted with a crash construction program, the president and the War Department grappled with the difficult question of where to place responsibility for this vital work. A complicated power struggle ensued between two major contenders, the Quartermaster Corps and the Corps of Engineers.

Veterans of the World War I cantonment program located in the Construction Division of the Quartermaster Corps argued their qualifications on the grounds of previous experience and tradition. Viewing the Quartermaster Corps as specialists in supply, Chief of Engineers Maj. Gen. Julian L. Schley headed an established construction organization staffed with the cream of the crop from West Point as well as graduates of the finest civilian engineering schools. Moreover, the civil works conducted by the Corps of Engineers had begun to dwindle significantly as funds were diverted into larger appropriations for the escalating military work, freeing the engineers to assume new activities.¹⁶

Initially, the Quartermaster Corps undertook the formidable job. Working against monumental odds, the highly centralized Construction Division struggled valiantly to put up housing for National Guard, Regular Army, and Army Air Corps units, as well as airfields and munitions plants. Although it achieved an impressive record of accomplishment, the Construction Division was unequal to the staggering task. Meanwhile, facilitated by the Reorganization Act of April 3, 1939, a series of reorganizations occurred within the War Department that gradually paved the way for eventual transfer of all military construction to the Corps of Engineers.¹⁷

A System of Airfields

Two actions late in 1940 resulted in the first substantial shift of responsibility. Approved October 9, 1940, the First Supplemental Civil Functions Appropriation Act for 1941 provided \$40 million for airport construction by the Civil Aeronautics Authority (CAA). The Corps of Engineers was to perform extensive survey and construction work for CAA. Soon thereafter, on November 19, 1940, construction at all Army Air Corps stations except those in Panama was ordered to be transferred to the army engineers without delay.¹⁸

As the year 1940 drew to its close, Galveston District personnel prepared to plunge into airfield construction throughout the state. They formed two groups, one to tackle CAA projects and the other to take on air corps construction. Working at first out of the Trust Building and after June of 1941 from the Santa Fe Building, these two groups extended their working hours in an effort to meet the demanding set of deadlines facing them. Office hours seven days a week and every evening after supper except on Saturday and Sunday became accepted routine.¹⁹

The CAA scheme provided for a system of airfields to be developed throughout the country. CAA fields would be used for military purposes as long as necessary and turned over to the municipalities furnishing the land when the threat to national defense had subsided. The government held recapture rights for future military use. The initial assignment to the Galveston District called for six fields.

Once a field had been authorized, the engineers studied weather data, scrutinizing wind statistics to determine prevailing direction and range of velocities. Next they sent men into the field to make contour maps on which the CAA runway system would be imposed. Then began the job of designing.

The fourteen men in the CAA group were soon turning out plans for at least one runway, taxiways, and apron areas at the rate of one airfield a week. By the end of March, 1941, the first CAA contract was awarded to

- *Airfield landing strip construction, World War II*





Building barracks for airmen

grade more than a million cubic yards of earth at Sweetwater. Work progressed steadily at other fields located at Corpus Christi, Houston, Waco, Austin, Galveston, Midland, Brownsville, Marfa, Kerrville, Beeville, Beaumont, and Alice. By 1943, the district had supervised construction and/or expansion of municipal airdrome facilities at eighteen CAA airfields costing approximately \$13 million.

Because of the favorable flying weather prevailing in southern and western Texas, this extensive region offered desirable sites for airfields, flying schools, and bombing ranges. Construction of new cantonment areas and airfield facilities at Ellington Field, the first air corps project assigned to the Galveston District, was transferred from the Quartermaster on December 16, 1940. By the end of January, 1941, the district was supervising barracks construction at Ellington, where the Tellepsen Construction Company was requesting authorization for overtime compensation to keep crews on the job ten hours a day, seven days a week. Skilled trades employed at that time included thirty-five electricians, twenty-two plumbers, nine steamfitters, seventy-four painters, four hundred carpenters, ten ironworkers, and fourteen sheet metal workers.²⁰

New air corps construction at existing installations (Brooks, Kelly, Randolph, and Duncan fields) was assigned to the Galveston District eleven days after the Ellington transfer. A field office was established at San Antonio to handle these modifications. The district also took over the completion of housing and technical facilities at Goodfellow Field near San Angelo as part of its early airfield work. By June of 1941, new flying schools had been authorized at Victoria's Foster Field, Mission's Moore Field, and at Harlingen, Waco, and Midland army airfields.

In acquiring the airfield construction, the Corps of Engineers inherited not only the projects themselves, but also the problems that accompanied them. Tremendous flexibility was essential to cope with the rapid volley of directives that incorporated increases in army strength, advances in aviation, shortages in manpower, materials, and equipment, and organizational and procedural changes.

The course of the Ellington Field project illustrates the irregular pace characterizing military construction. The first directive was issued to the Quartermaster Corps on July 29, 1940. Originally, the project called for construction of 182 cantonment buildings to house a bombing training center with accommodations for 2,979 enlisted men, 265 officers, and 610 cadets. Contractors began construction on September 12, 1940 for an estimated \$3,969,000. By the end of 1942, the capacity at Ellington Field had been increased to 8,250 men and the cost had risen to \$11,042,000.²¹

Dating back to World War I, Ellington Field was a turfed, all-over flying field hampered by slow surface drainage. Lightweight aircraft could operate on the field under dry conditions only. As late as November 29, 1940, an inspector reported:

The repair of existing subsoil drains, deepening of the canals and improvement of field drainage into the deepened canals appear to be considered by the Office of the Chief of Air Corps as adequate preparation of the field for flying operations. That office states that paved runways will not be constructed.²²

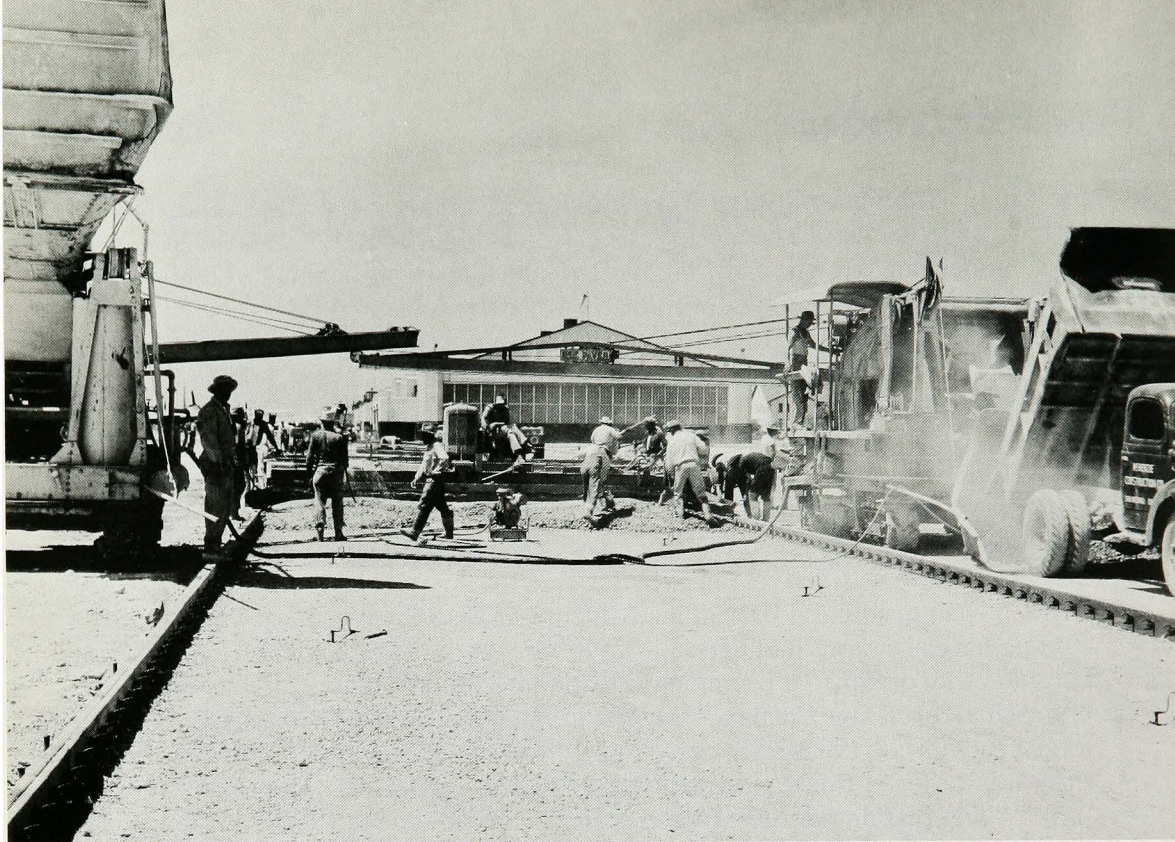
Within two months, Galveston District Engineer Maj. (later Col.) Leland Hazelton Hewitt, was corresponding with the Portland Cement Association, comparing various types of pavement for what would become the largest medium bomber training base in the country, covering 1,192 acres with a total paved area of 990,794 square yards.²³

Major Hewitt was one of several graduates of the two West Point classes of 1918 who directed Galveston activities during the war years. He had followed his graduation in June, 1918 with postgraduate training at

the Camp Humphreys (later Fort Belvoir) Engineer School and Massachusetts Institute of Technology, from which he earned a B.S. degree in civil engineering. Hewitt was assigned to Galveston in the summer of 1939 and became district engineer on January 13, 1941, soon after the transfer of airfield construction. He led the district through the wildest months of war construction, leaving in December of 1942 to serve in Australia and the Philippines. Later he was appointed chief engineer of the Far East Air Force on General MacArthur's staff. After his retirement from the army in 1954, he was named United States Commissioner of the International Boundary and Water Commission, United States and Mexico.²⁴

Shortly after the airfield transfer, Maj. (later Col.) David Wood Griffiths was ordered to Galveston to assist Hewitt. An exceptional student, Griffiths had graduated first in his November, 1918 class at West Point. Among his classmates had been Leslie R. Groves, the Galveston District alumnus who occupied a prominent position in the Construction Division of the Quartermaster Corps prior to the U.S. entry into World War II and later headed the vital Manhattan Project. The newly commissioned Griffiths was ordered to attend the civil engineering course at Camp Humphreys. Overcoming deficiencies in transportation between Washington and the camp, he arrived along with several of his enterprising classmates atop a pile of lumber on a freight car. A series of engineering and teaching assignments followed graduation from the engineer school as well as foreign tours of duty where he put his linguistic talents to good use. Griffiths worked with the military projects in Galveston from January, 1941 until March, 1942. Late in the war, he moved to England as assistant to the engineer of Supreme Headquarters Allied Expeditionary Forces (SHAEF) and as chief of transportation with responsibility for the detailed studies and planning for the artificial harbors for the invasion of France. Griffiths would return to Galveston in July, 1945 for a two-year stint as district engineer.²⁵

Designing runways to bear the weight of new and heavier planes posed an unprecedented challenge to the Corps of Engineers and represented one of its greatest technical accomplishments. Due to the novelty of paved airfield construction, no regulations or criteria existed. Without guidelines, the engineers were forced to arrive at many decisions arbitrarily, relying heavily on applied judgment. Once the choice had been made to pave Ellington with concrete, the question arose of what thickness to use. Tom Elam, chief of the Design Branch, discussed this problem with a material salesman one day. The salesman, a practical man, asked Elam if the street in front of the Santa Fe Building would support the aircraft to be used. Elam responded affirmatively. Together they decided that the street, paved with brick and asphaltic concrete, would



Paving parking apron at air force base

be equivalent in strength to about 6 inches of concrete. In that fashion, the thickness of the Ellington runway pavements was determined.²⁶

The concentrated effort for airfield construction continued throughout 1941 and was greatly accelerated after the United States entered the war in December. In 1942, many completely new airfield installations were authorized: Matagorda, Eagle Pass, San Angelo, Blackland, Big Spring, Bergstrom Army Air Field at Austin, Aloe at Victoria, Galveston, Palacios, Bryan, and Brownsville.

On December 1, 1942, revision of the Southwestern Division to conform to the boundaries of the Eighth Service Command enlarged the military boundaries of the Galveston District to encompass a large part of Louisiana. Included among the Army Air Force stations transferred at that time were Harding Field at Baton Rouge, Hammond, Moissant at New Orleans, DeRidder, and Lake Charles.²⁷

By 1943, in just a little over two years, the district had to its credit construction of nineteen new army air fields, complete with cantonment and airdrome facilities, plus expansion of and supplementary construction on nine more fields at a cost of approximately \$158.4 million. An extraordinary accomplishment in itself, the airfield construction comprised just the tip of the iceberg as the final months of 1941 approached.

Engineers Shoulder the Entire Load

While the strengths of the Corps of Engineers organization were being put to test during the first year of the airfield program, the move to transfer all military construction from the Quartermaster to the Corps of Engineers was gaining momentum. Relying on their time-honored practice of decentralized operations, army engineer districts applied to air corps work methods that had proved successful in rivers and harbors construction. They embarked upon scientific research into the strength of runway pavements and bearing capacities of soils, setting up laboratories to investigate concrete, asphalt, and soils.

On December 1, 1941, President Roosevelt signed into law a bill providing for all army construction to be placed under the Corps of Engineers. The transfer became effective on December 16, 1941, nine days after the Japanese attack on Pearl Harbor.²⁸

Following the declaration of war, military construction increased greatly. There came calls for camouflage at stations within air frontiers, additional runways and auxiliary fields to permit wider dispersal of planes, intermediate general depots to regulate flow of supplies to coastal ports, and special ammunition loading piers at all principal ports. Munitions work was stepped up.²⁹

One year earlier, on December 30, 1940, nine territorial construction zones had been established to correspond to the boundaries and headquarters of the nine army corps areas (later called service commands). Each was headed by a zone constructing quartermaster responsible to the quartermaster general. With the transfer of all army construction, these quartermaster construction zones became districts under the Corps of Engineers organization. The former quartermaster zone for the Eighth Army Corps Area at San Antonio became the San Antonio Engineer District, sharing construction with the Galveston District throughout the war. Military boundaries within divisions were not rigid, the work load being the determining factor in assignments.³⁰

During the first half of 1942, the Galveston District assumed a crushing load of old and new work in the face of mounting shortages of every kind. By mid-April, the district was handling construction to accommodate 65,967 men involving sixty-six active contracts at an estimated cost of \$153,589,000.³¹

Fixed-price agreements arrived at by competitive bidding had been used by the army engineers in contractual arrangements for many years. The urgency of wartime construction, however, demanded a swifter, more flexible system. During World War I, the Quartermaster had used at first cost-plus-percentage-of-cost contracts. As these proved excessive

in expense, they were superseded by cost-plus-fixed-fee contracts, which sped up construction and held down contractors' profits somewhat.

On July 2, 1940, the secretary of war was empowered to let contracts "with or without advertising"; cost-plus-percentage contracts were forbidden, but fixed-fee arrangements were permitted. Formal advertisement came to be replaced by a system of competitive negotiation, under which quotations were solicited from selected bidders. Contract procedures changed a number of times as the war ran its course.³²

Huge sums were involved. Taking bids for work on Goodfellow Air Force Base at San Angelo, Galveston's Col. Wilson G. Saville showed the bulky set of plans to a man from Brown and Root. The civilian engineer casually flipped through the plans and rendered an offhand estimate of \$25 million. Somewhat nonplussed, Saville asked if he were bidding on the plans by the pound.³³

Eventually, renegotiation was introduced to curb profiteering. The first Renegotiation Act, approved April 28, 1942, enabled the government to recover excessive profits. A San Antonio contractor is reputed to have sent the army a refund check for \$1 million even before renegotiations began.³⁴

One of the most pressing legacies the engineers acquired from the Quartermaster Corps was the urgent need for facilities to support a vital munitions industry. Construction of the San Jacinto Ordnance Depot for ammunition storage was transferred to the Galveston engineers almost immediately. A plant at the Baytown Ordnance Works to produce toluol, an organic compound used in the manufacture of TNT, was another of the district's first ordnance projects.

On January 6, 1942, Galveston received a directive to construct Dickson Gun Plant, a new installation on the Houston Ship Channel for manufacture of gun tubes. Within ten days, Griffiths was requesting priority rating for the project. Subsequently classified A-1-a, the gun factory construction entailed utilities including water supply, a distribution system, sanitary sewers, sewage disposal, storm sewers, power connections, roads, railroads, gas line, docking facilities, and fencing. Structurally, the complex called for an administration building, gun-casting shop, heat-treating shop, receiving and shipping facilities, and storage buildings. Revised specifications were required in February "to meet critical machine tool situation" and to incorporate new developments in centrifugal casting technique. The project was completed by December 20, less than a year from its initiation, and ready for the using agency, Hughes Tool Company, to move in and begin production.³⁵

Still another entirely new facility at McGregor was authorized early in March. The Bluebonnet Ordnance Works, to be operated by the National Gypsum Company, was a bomb-loading plant containing bomb-loading

lines, a booster-loading line, and an ammonium nitrate-crystallizing line. The efficiency with which this plant was erected is reflected not only in the fact that it was completed by November 15 of the same year, but also in this inspection report by an official from Washington:

It appears that the organization on this job is probably one of the best on any of the Bomb Loading Plants. Work seems to be ahead of that at any of the other plants which were started at approximately the same time. The Area Engineer appears to be on his toes and the District Engineer appears to be very much interested in the project and has decentralized as much responsibility as possible to the Area Engineer.³⁶

By summer, the district was engaged also in expanding the Texas Electric Steel Casting Company. The Baytown Ordnance Plant was equipped with protective measures such as bomb splinter walls and air raid shelters. By 1943, the district had accomplished construction totaling \$35 million in the five ordnance installations on which it worked. Further additions and modifications continued after the plants became operational.

Since camps and cantonments constituted the first major thrust of the Quartermaster's construction program, these were largely completed by the time of the transfer to the Corps of Engineers. The Galveston District performed supplementary construction at many existing ground troop stations throughout the state during the remainder of the war. A new program launched in March, 1942 resulted in construction of a three-thousand-man enemy internment camp at Huntsville, followed by two more at Mexia and Hearne. Absorbing the Louisiana military work in December, 1942, the district took on Camp Polk, LaGarde General Hospital, New Orleans Staging Area, other installations composing the New Orleans Port of Embarkation, and prisoner-of-war camps at Camp Polk, Camp Livingston, and Ruston. By the end of the year, personnel strength in the Galveston District approached four thousand employees.

Fortifications for the Gulf Coast

Although seacoast fortifications had remained continuously under the jurisdiction of the army engineers, the Galveston District had been charged with no work of this type since the early 1920s. But World War II would find German submarines entering the Gulf, sinking merchant ships, and menacing coastal ports and industries. During 1941, a fortifications section was set up, headed by Edwin A. Pearson. As preparation for his new and unfamiliar assignment, Pearson received a single sheet of paper

containing a drawing of a casemate. His first task was the sizable job of casemating Battery Hoskins at Fort Crockett to withstand an attack of five-thousand-pound naval shells. Prior to construction of the protective casemating, the projectile rooms, powder rooms, and plotting rooms were covered by concrete and earth and the two 12-inch barbette guns stood in the open.³⁷

The fortifications section designed two heavy casemates and the mechanical and electrical equipment to update the guns. Unlike the other military construction where the work was contracted out, the harbor defenses were built by a special fortifications construction force composed of district personnel. The work at Battery Hoskins was conducted under such a cloak of secrecy that at a celebration of its completion early in 1943, District Engineer Col. Wilson G. Saville announced facetiously that he was extending congratulations for something he knew nothing about.

Colonel Saville was another of the distinguished officers who led the district during the war years. His unusual life began in 1897 at Fort Sill, which was then an Indian reservation. His father was the army officer in charge of the Oklahoma reservation and Chief Geronimo stood as the young lad's godfather. Saville graduated from the November, 1918 class at West Point and attended postgraduate courses until 1920, when he resigned from the army to enter the oil business. With the introduction of geophysics, Saville recognized the importance of this new development to oil exploration and organized the first American geophysical consulting company.³⁸

The outbreak of World War II prompted Saville's return to military life. Offering his services to the army, he was assigned to Galveston where he subsequently succeeded Hewitt as district engineer early in December, 1942. After leaving Galveston late in 1943, he moved to the European Theater of Operations where he served on General Eisenhower's top level staff as chief of operations for the SHAEF Engineering Division. In August, 1945, he returned to civilian life.³⁹

In addition to casemating Battery Hoskins, the district rehabilitated other of the old batteries and constructed two identical new batteries. Battery 235 at the west end of Fort San Jacinto and Battery 236 at Fort Travis each consisted of sleeping quarters, plotting, powder, power, and projectile rooms, protection by overhead concrete and dirt, and two extremely accurate long-range 6-inch guns. Battery Mercer at Fort San Jacinto was air-conditioned, gas proofed, and turned into the Harbor Entrance Control Post to direct the defenses of Galveston. Still other provisions included some 110-foot steel observation and fire control towers on the island and on Bolivar, an anti-aircraft battery at the end of the south jetty, and numerous searchlights.⁴⁰

Fortifications work extended the width of the entire Texas-Louisiana coastline. Galveston engineers designed and constructed harbor entrance defenses at Brownsville, Port Aransas, Sabine, Cameron, and Burrwood. Also, they constructed emplacements for mobile 155-mm. guns on the beaches all along the coast. Surveillance radar stations, some camouflaged to resemble water towers, and aircraft warning stations provided further protection.⁴¹

At the three Galveston forts, the district modernized and constructed accommodations for the artillery troops — barracks, mess halls, laundries, warehouses, chapels, recreation buildings, and hospitals. At Freeport, it erected a small city to house troops manning the harbor fortifications.⁴²

Although the peak of the military construction push had been passed by summer of 1943, the district continued to expand and alter existing facilities and to undertake new construction to meet continuously changing and specialized training needs. Men who had been deferred from military service for the critical construction during 1941 and 1942 now moved overseas as American efforts there intensified. If, however, construction pressures abated somewhat during this period, acute shortages of labor, materials, and supplies did not.

The district's military supply program had begun in the last quarter of 1941 with a small number of purchases of burlap, sandbags, used rail, and miscellaneous small items. The program to obtain materials and equipment used by engineer troops at home and abroad was activated in 1942. During that year, Galveston assumed production and inspection responsibilities for \$2.9 million of supplies aggregating over fifty-five thousand tons. By 1943, the program had grown tremendously to encompass production, inspection, and shipping responsibilities for a total of \$4 million worth of supplies representing a growing diversity of items. Mounting scarcities of materials and labor caused enormous problems. The Galveston District assisted the Southwestern Division Military Supply Procuring Office in persuading manufacturers to undertake contracts for items entirely outside their normal line in the midst of capacity business and almost certain difficulties.

Critical shortages inspired substitutions and ingenuity of all kinds. To cope with the lack of manpower, resourceful M. R. Royar, district personnel officer, resorted to unconventional measures:

It was so difficult to hire men that I worked out arrangements with the jail officials to release their "birds" to us for employment on our dredges. All Civil Service restrictions for employment were rescinded and the general criteria for hiring

was "Hire as long as the body is warm." Believe it or not, that is the way it actually worked as men were so scarce.⁴³

In all, Galveston District accomplished over \$225 million worth of military construction during World War II. The scope of wartime operations was enormous and the list of projects, seemingly endless. Like their counterparts in other army engineer districts, the men and women from Galveston could take immense pride in their contributions to the total war effort.

The Military Finale

Late in World War II, Galveston District began a long-term program of master planning for many army posts and air force bases in Louisiana and Texas. In existing installations, a primary objective was to replace

Lackland Air Force Base. View looking south shows barracks and 1,000-man mess hall in foreground, July 6, 1951.





Barracks construction at Fort Sam Houston

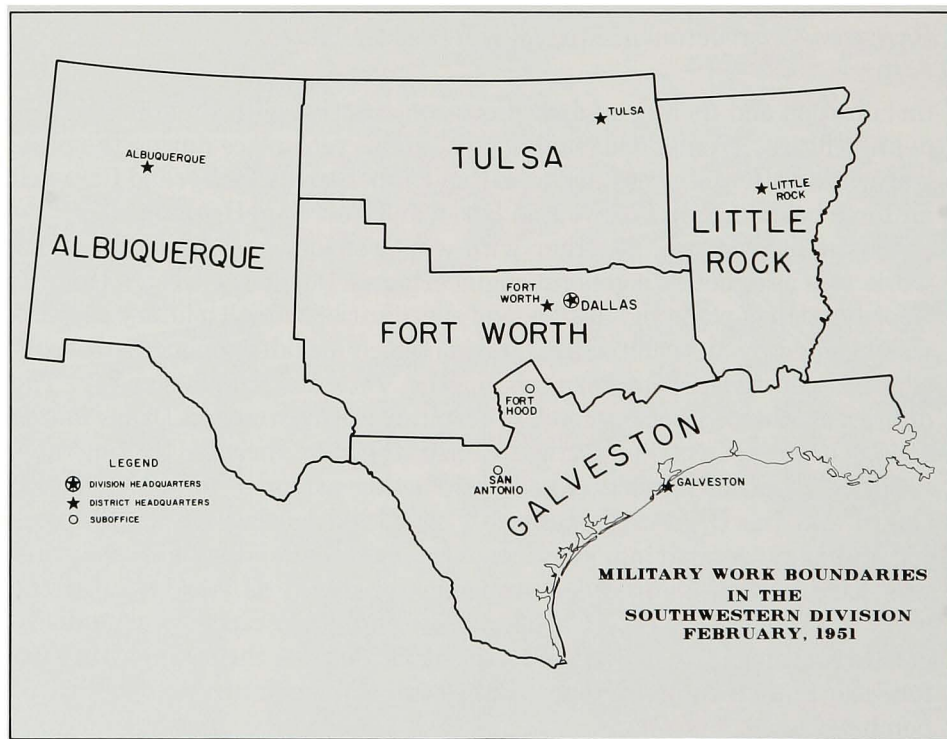
mobilization and theater-of-operations construction with superior, permanent facilities. Tremendous building programs took place during the post-war years at Bergstrom, Lackland, Randolph, Brooks, Kelly, and Carswell air force bases, Camp Polk, Camp Hood, and Fort Sam Houston.

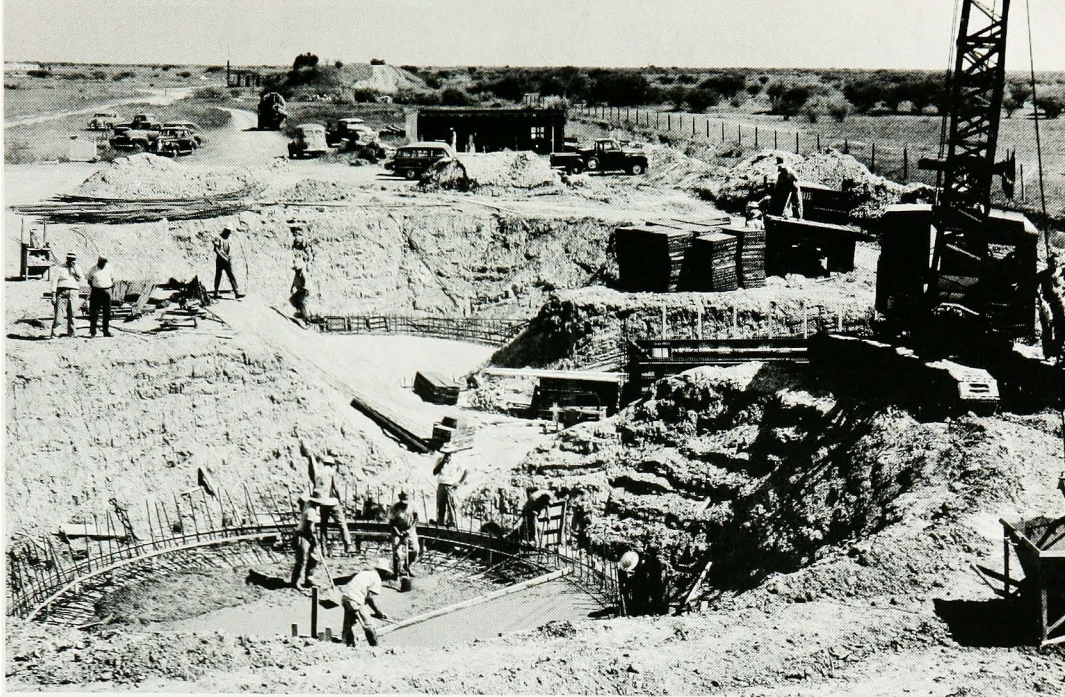
This military work, together with what remained of the fortifications work, was assigned to a general engineering section in the Design Branch. Coordination of planning, design, and specifications for all military projects was handled by an architectural section which included among its responsibilities construction of hospitals for the Veterans Administration. The district awarded contracts for VA hospitals in Houston and Dallas late in 1946. Other projects undertaken after the war included adding new facilities at national cemeteries, constructing armories for the National Guard and the Organized Reserve Corps, and leasing scores of offices for military recruiting services. An extensive disposal program was handled for hundreds of properties classified as surplus after the war. In one instance, the Corps clashed with local ranchers who disregarded warnings to remove their grazing cattle from the open pasture before the Fourth Army detonated shells remaining from the deactivated bombing range.⁴⁴

With the outbreak of hostilities in Korea in June of 1950, the district was once again off and running. The Design Branch gathered plans for existing installations and the Real Estate Division busied itself recapturing deactivated sites.⁴⁵ A number of former bases (Laughlin, Harlingen, Laredo, Foster, and Lake Charles) had to be built almost anew. Many other installations became scenes of large-scale rehabilitation, expansion, and new construction. Military work took priority, pulling many district employees off their work on civil projects. Personnel strength, 485 at the beginning of June, grew rapidly, especially after February of the following year, to 737 by the end of September, 1951.

Toward the end of 1950, intervention by the Chinese Communists in Korea and the presidential declaration of a national emergency in the United States intensified military construction efforts. A portion of Galveston's military work in Upper Texas was ordered transferred to the ten-month-old Fort Worth District effective February 1, 1951.⁴⁶ Soon thereafter, military activities increased dramatically. By August 18, 1951, Galveston District was administering 116 active contracts for construction, services, and equipment.

Once again, to meet the urgent pressures of war, all work was done under contract. With the experiences of World War II under its belt, the





Constructing sewage treatment plant at Foster Air Force Base in Victoria

Corps approached contractual arrangements more stringently, resuming its former practice based on fixed-price agreements. For rehabilitation at San Marcos Air Force Base, several days were spent negotiating eleven hundred bid items. Once the job was underway, the contractor pushed so energetically that during a single two-week period, he accomplished \$1 million worth of work.⁴⁷

A huge training center for air force inductees, Lackland suffered an acute shortage of accommodations. At first, tents with folding cots were used. As the situation grew steadily more critical, the men were reduced to sleeping in shifts on the cots. Mothers voiced their indignant complaints over these arrangements for their sons, stimulating remedial authorization for a \$5 million rush job. Design Branch architects plunged into the project on an around-the-clock basis and, within 150 days, the Construction Division had completed fine new barracks and a one-thousand-man mess, resplendent with stainless steel kitchen equipment.⁴⁸

An important and challenging project acquired by the district during the Korean Conflict was the Michoud Ordnance Plant in Louisiana. Chrysler operated this facility to produce engines for armored tanks. In spring, 1951, work began on an engine test cell building. Because of foundation soil conditions at New Orleans, the reinforced concrete structure had to be built upon wooden piling, 70 to 80 feet long.⁴⁹

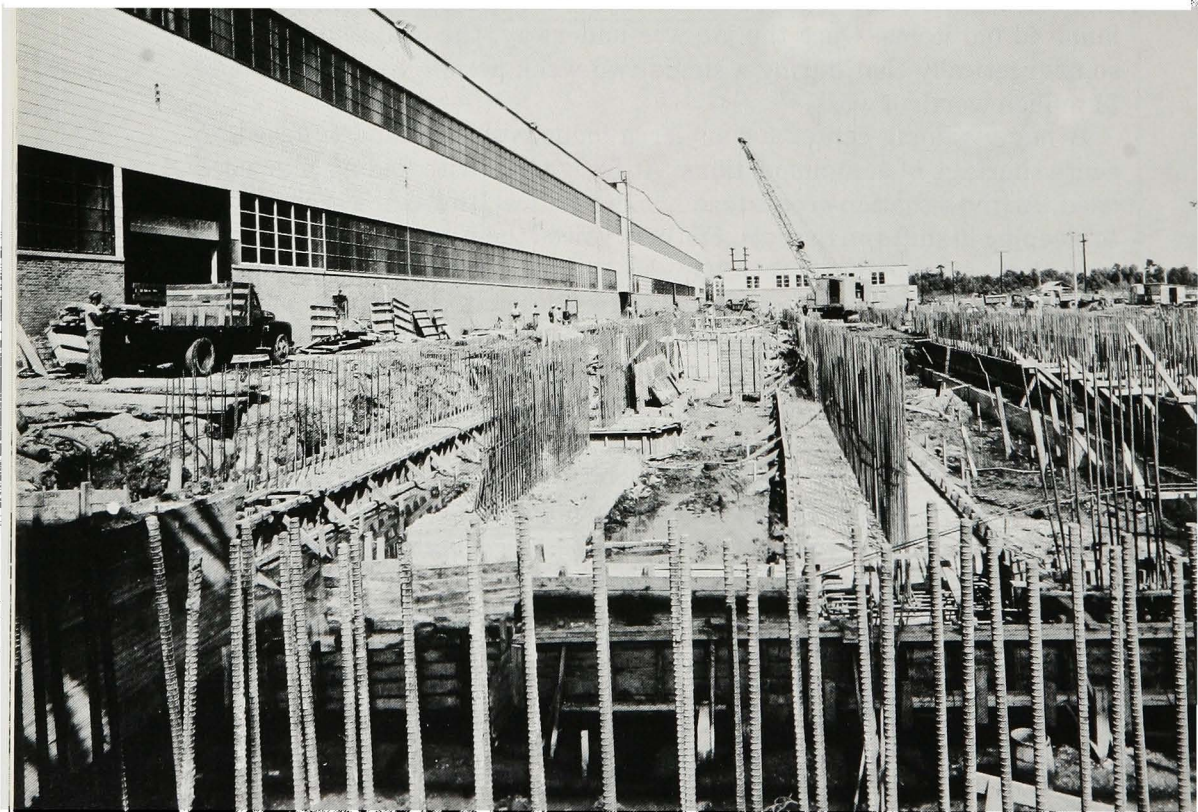
The main plant building encompassed 40 acres beneath one roof. Its size was so gigantic that personnel resorted to using rubber-tired roller skates

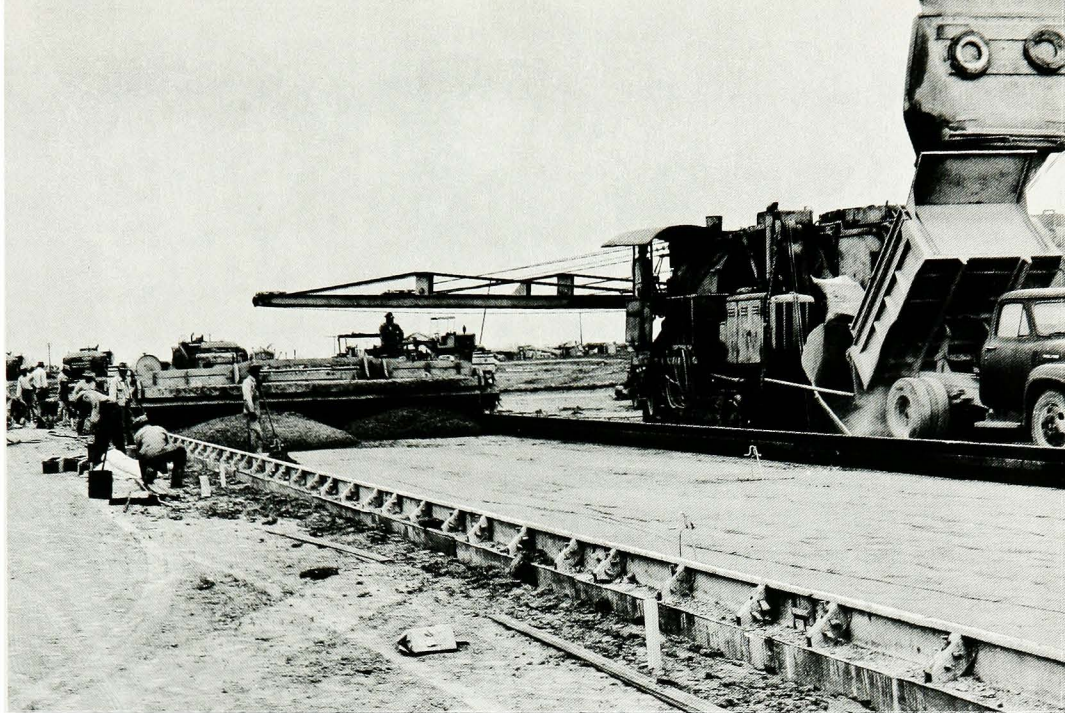
and motorcycles with sidecars to move around inside the building. Predating the Houston Astrodome by more than a decade, the Corps of Engineers air-conditioned this gargantuan expanse of space. The task required a power plant containing seven eleven-hundred-ton compressors and a two-story high, twenty-two-hundred-ton compressor. Throughout the 1950s, the district continued to construct improvements totaling millions of dollars at the Michoud plant.⁵⁰

Two new bases were developed to support the atomic missile program: Gray Air Force Base near Fort Hood and Medina Base near San Antonio. Construction at both bases involved igloos for missile storage as well as housing and other amenities. The district built special roads to connect storage facilities at Medina Base with Kelly Air Field.⁵¹

Early in the Korean Conflict, construction began on a system of border defense for the Air Force. To detect incoming planes from the Gulf as well as from the Texas-Mexican border, several central and many satellite radar stations were located on high ground from El Paso to New Orleans. The district performed work on this aircraft warning system throughout the decade.⁵²

Footings for walls of engine test cell building at Michoud Ordnance Plant in New Orleans, August 29, 1951

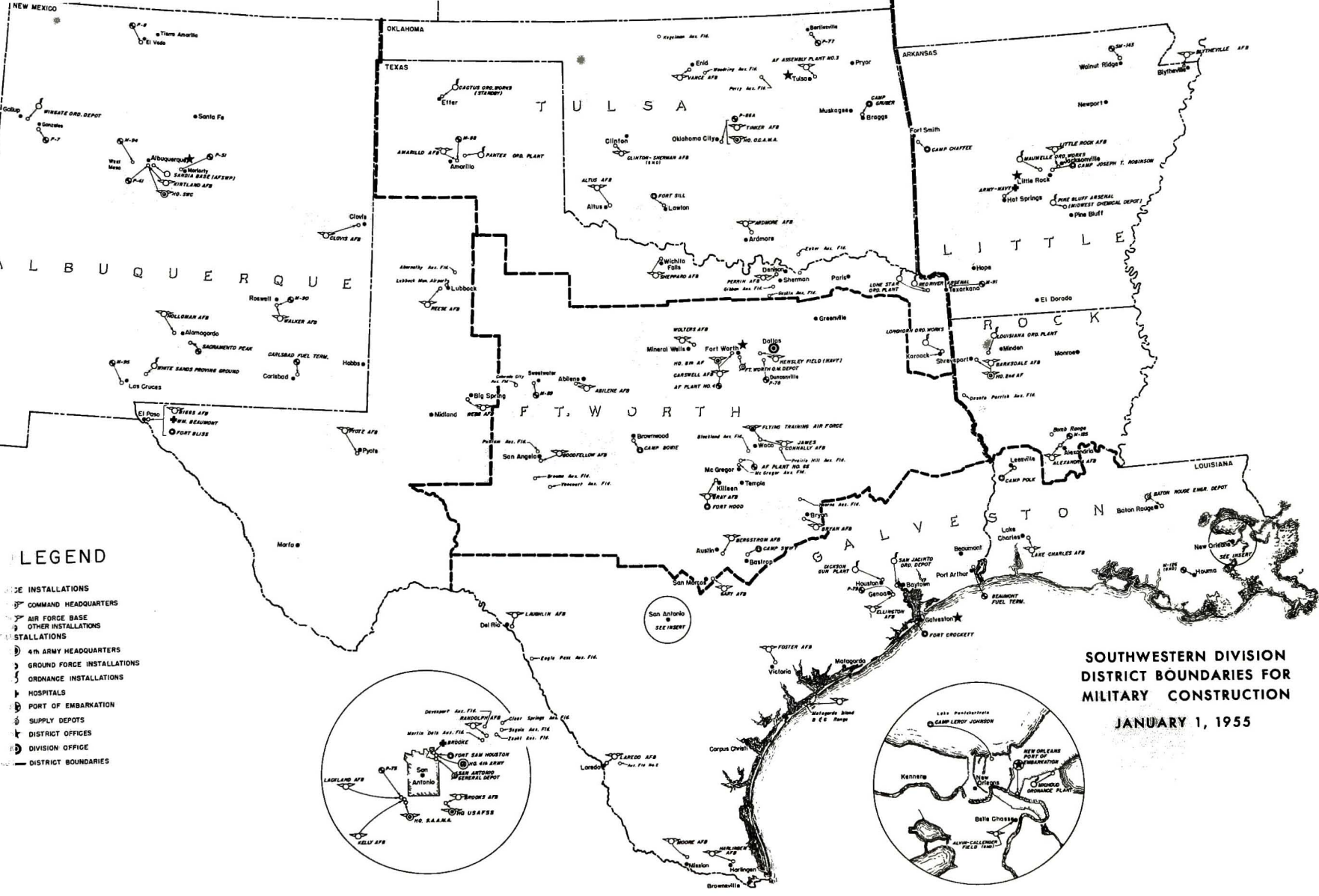


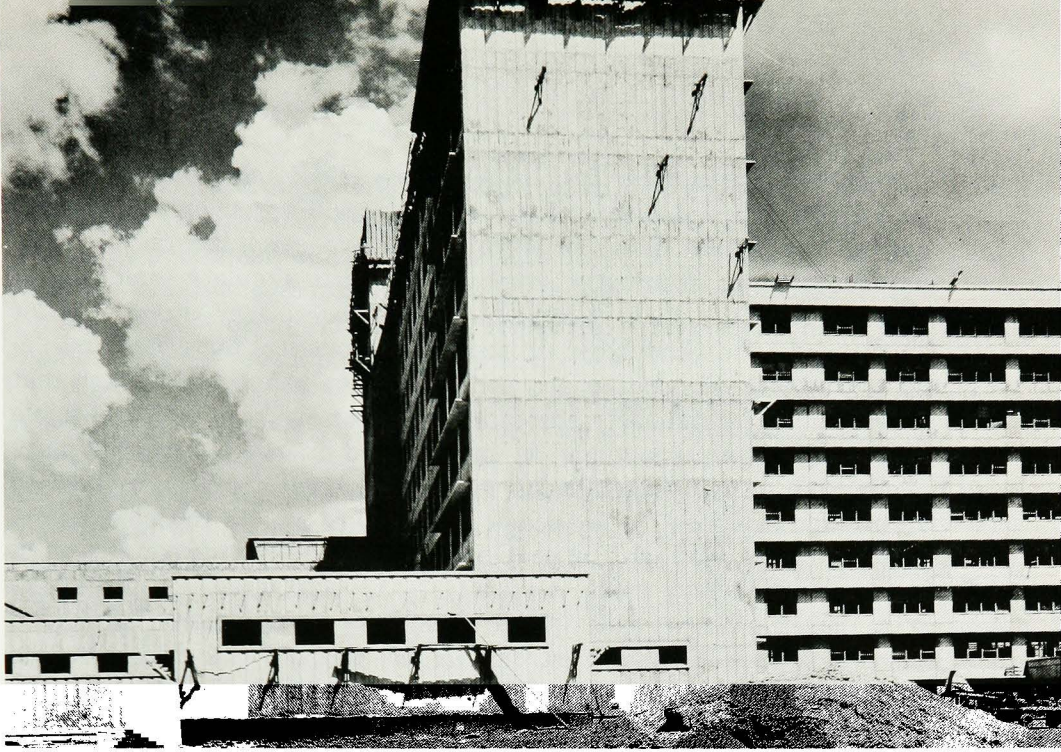


Building runways at Lake Charles Air Force Base to accommodate jet bombers

Ground force maneuvers by the Fourth Army Second Division, stationed at Fort Hood, involved the Galveston District in an activity of a different nature. Designated "Operation Longhorn," the maneuvers required the already very busy Real Estate Division to obtain permits for the soldiers to cross a sizable amount of land in Central Texas. Negotiators hired to obtain the permits issued assurances that any property damages would be repaired. After the first maneuvers, some landowners were understandably reluctant to subject their property to a repeat performance. Opposition became so staunch that finally the entire operation was moved to Louisiana. There, the Real Estate Division acquired temporary permits for 7 million acres, almost the entire western half of the state up to the Arkansas border, and rights to cross the Red River. After the maneuvers came restoration of the river banks and settlement of damages. Among the less routine claims was that of one man who demanded \$10,000 for a single pecan tree that had been picked clean by the troops.⁵³

Generally, construction during the Korean Conflict improved upon that of World War II, using better materials, such as reinforced concrete and masonry, and meeting higher technical qualifications. Airfield design had come a long way in ten years. New runways, 11,000 by 300 feet, constructed at Kelly and Lake Charles, featured 2-foot thicknesses of pavement. Numerous airfields were built to accommodate heavy bombers.





Wilford Hall, under construction at Lackland Air Force Base

The newly constructed barracks at Lackland afforded a palatial contrast to those of World War II vintage. Other unusual accomplishments included a security service headquarters building at Kelly and a celestial navigation training building resembling a planetarium at Ellington.⁵⁴

After the signing of the armistice in 1953, the Galveston District continued to carry a heavy military load. An interesting foundation problem persisted at the bases around San Antonio and Austin. Along the Balcones fault that was formed more than 70 million years ago, the top layer of Edward limestone had long since weathered out, leaving a spongy black clay. So highly reactive to moisture conditions that the ground soil literally "heaved," this clay caused considerable trouble. To overcome this handicap, huge drilled and underreamed footings were built, based below the zone of seasonal moisture variation sometimes as deep as 93 feet, to provide foundations for large structures like the Kelly security building.

The district built many such buildings. The Special Air Materiel Command Warehouse at Kelly covered 480,000 square feet. A method of vacuum processing was used to cure the concrete in mass-producing the 2,880 "Texas size" panels, 5 by 33 feet, for the warehouse roof. Still another highlight of this postwar period was Wilford Hall, the ultimate in air force hospital facilities, at Lackland. This five-hundred-bed facility, erected between 1954 and 1957, was the first architectural concrete structure of its size in the vicinity.⁵⁵

Meanwhile, at nearby Brooks Air Force Base, construction of the School of Aviation Medicine (Aerospace Medical Center) entailed unique features never built before or since. A brick research laboratory building housed sound attenuation rooms designed to simulate conditions in outer space. To achieve maximum sound absorption, the contractor (Farnsworth and Chambers) utilized soft, acoustical materials and developed a wall configuration incorporating wedge-shaped projections that baffled sound. A radioactive area intended for study of every possible radiation problem that might be encountered in space presented more complicated design challenges. A mechanical hand operated by remote control and a protective periscope device were among the designs developed by the contractor in cooperation with the Southwest Research Institute for this high energy area.⁵⁶

By 1959, the district had added to its military construction Nike Guided Missile facilities at the Bergstrom Defense Area. Work progressed as usual for the next couple of years until a memorable Good Friday in 1961, when personnel were summoned to the Santa Fe Building and informed that Galveston would be relieved of its military assignment and possibly made an operational district only. Orders dated May 22, 1961 followed, transferring all responsibilities for military construction and military real estate in the Southwestern Division to Fort Worth and Albuquerque districts as of July 1, 1961. Removal of the military mission cut personnel strength drastically. Subsequent organizational readjustments included conversion of the Construction Division into a branch under the Operations Division. In 1967, this unit became the Construction-Operations Division.⁵⁷

Almost coinciding with the transfer of the military mission, civil defense was placed under the secretary of defense and a National Fallout Shelter Program established as a national objective in May of 1961. Galveston District set up a Civil Defense Support Branch to institute this program in the coastal area from Brownsville to the Sabine. This branch trained architect-engineers to identify and evaluate structures capable of protecting against radiation fallout, designated shelter areas with appropriate signs, supervised surveys to locate potential shelters for communication facilities in the National Emergency Broadcast Net, and assisted municipal authorities in preparing public information. The district continued work on this program well into the 1960s.

Galveston regained a fraction of its former military work on September 1, 1972 with return of the real estate function: acquisition, leasing, and disposal of property for military and postal service facilities within an area corresponding roughly to the civil boundaries. Relieved of the postal work on June 30, 1973, the district continues to manage the remaining military

work, consisting largely of providing recruiting facilities for all four branches of the armed forces and furnishing housing for army and air force recruiting personnel. Since the decision to phase out Ellington Air Force Base and Matagorda Island Bombing Range was announced in November, 1974, Corps real estate personnel have been disposing of land, buildings, and personal property at both installations.

Pride in the district's accomplishments during the years of its military mission runs justifiably high. Although the pace, diversity, and magnitude of military construction activities defy any palatable form of inclusive description, the chief of the Construction Division during the 1950s, Wilbur Laird, summed them up rather well. Recalling the pool of engineering talent built up in Galveston during that time, he submits, "We had a group that could have built anything in the world."

Notes to Chapter 7

¹ Earl Wesley Fornell, *The Galveston Era: The Texas Crescent on the Eve of Secession* (Austin: University of Texas Press, 1961), p. 26.

² Board of Engineers (Col. Henry L. Abbot, Col. Henry M. Robert, Lt. Col. G. L. Gillespie, and Maj. C. W. Raymond) to Brig. Gen. W. P. Craighill, 12 July 1895, Carton 27, File no. 660.2, (Gen.) Artillery & Torpedo Defenses of Galveston, 1895-1920, Galveston District Fortification Files (GDFF) (hereafter cited as Board to Craighill).

³ *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1868* (Washington, D.C.: Government Printing Office, 1868), p. 505 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).

⁴ Board to Craighill; *ARCE*, 1880, p. 51.

⁵ *ARCE*, 1900, p. 6; Board to Craighill.

⁶ *ARCE*, 1896, p. 524; *ARCE*, 1898, p. 765; *ARCE*, 1897, pp. 741, 19-20.

⁷ *ARCE*, 1898, pp. 10, 29, 769-70; *Encyclopaedia Britannica*, 14th ed., s.v. "Spanish-American War."

⁸ Brig. Gen. John M. Wilson to Lt. C. S. Riché, 19 April 1898, Carton 27, File no. 660/171, (Gen.) Mines, Torpedoes, & Batteries, 1898-1911, GDFF; *ARCE*, 1895, p. 6; *ARCE*, 1899, pp. 964-65.

⁹ In accordance with custom pertaining to all fixed armament, the original batteries at Fort San Jacinto were named after valiant soldiers: Julius Heileman (two 10-inch breech-loading rifles), Hugh Mercer (eight 12-inch mortars), John Hogan (two 4.7-inch rapid-fire guns), and George Croghan (two 15-pounder rapid-fire guns). *Galveston Tribune*, 17 October 1923; H.R. Doc. 132, 56th Cong., 2d sess. (1900), p. 4.

¹⁰ Batteries at Fort Crockett were: Wade Hampton (two 10-inch breech-loading rifles), George Izard (eight 12-inch mortars), and Jacint Laval (two 15-pounder rapid-fire guns). At Fort Travis, batteries Thomas Davis and Rudolph Ernst contained two 8-inch breech-loading rifles and three 15-pounder rapid-fire guns. *Galveston Tribune*, 17 October 1923; H.R. Doc. 132, 56th Cong., 2d sess. (1900), p. 4.

¹¹ *ARCE*, 1901, p. 31.

¹² H.R. Doc. 132, 56th Cong., 2d sess. (1900), p. 4; *ARCE*, 1901, p. 32.

¹³ *Galveston Tribune*, 17 October 1923.

¹⁴ Battery Hoskins was named in memory of Second Lt. Leonard C. Hoskins, who died in action during 1918. It housed two 12-inch barbette breech-loading rifles. Battery Kimble honored Maj. Edwin R. Kimble of Galveston who also lost his life overseas during World War I. *Galveston Daily News*, 10 June 1921; *Galveston Tribune*, 17 October 1923.

¹⁵ Lenore Fine and Jesse A. Remington, *The Corps of Engineers: Construction in the United States*, United States Army in World War II (Washington, D.C.: United States Army, 1972), p. 4 (hereafter cited as Fine & Remington, *Construction in the United States*).

¹⁶ *Ibid.*, p. 89.

¹⁷ *Ibid.*, pp. 123, 89.

¹⁸ *Ibid.*, pp. 252, 255.

¹⁹ Interview with Jonathan L. Ransom, 3 October 1975, provided considerable background for the discussion of airfields in this chapter.

²⁰ Lt. Col. S. L. Scott, Southwestern Division Engineer, to Office of the Chief of Engineers (OCE), 28 January 1941, Engineer Historical Division (EHD) files, Baltimore.

²¹ Office of Inspector General, "Report of Special Inspection of Emergency Construction at Ellington Field, Texas," 29 November 1940, EHD (hereafter cited as IG, "Report of Special Inspection"); OCE, *War Construction, Monthly Progress Report*, no. 60, 31 December 1942, EHD.

²² IG, "Report of Special Inspection."

- ²³ *Airport Drainage* (Middletown, Ohio: Armco Drainage and Metal Products, Inc., 1948).
- ²⁴ U.S. Military Academy Association of Graduates, *Assembly*, Fall 1964.
- ²⁵ *Ibid.*, Fall 1969.
- ²⁶ Ransom interview.
- ²⁷ Organization of the Army Air Forces occurred in June, 1941. Fine & Remington, *Construction in the United States*, p. 457.
- ²⁸ *Ibid.*, pp. 472, 476.
- ²⁹ *Ibid.*, p. 479.
- ³⁰ *Ibid.*, pp. 263, 487; Memo, Maj. Gen. E. Reybold, OCE, to Division Engineers, 27 October 1942, File no. SPEGC, EHD.
- ³¹ OCE, *Progress of War Construction*, no. 49, 15 April 1942, EHD.
- ³² Fine & Remington, *Construction in the United States*, pp. 119, 574.
- ³³ Ransom interview.
- ³⁴ Fine & Remington, *Construction in the United States*, p. 579; Telephone interview with Wilbur Laird, 11 December 1975.
- ³⁵ Lt. Col. D. W. Griffiths to Chief of Engineers, "Request for Priority Rating for New Project," 16 January 1942, EHD; Maj. H. B. Sheets, Ordnance Dept., to F. R. Creedon, OCE Construction Division, "Revised Information Required for Negotiation of Collateral Contract Changes," 18 February 1942, EHD; OCE, *War Construction, Monthly Progress Report*, no. 60, 31 December 1942, EHD.
- ³⁶ G. F. Widmyer, OCE, to Creedon, "Inspection Trip — Bluebonnet and Pantex Ordnance Plants," 4 May 1942, EHD.
- ³⁷ Interview with Edwin A. Pearson, 11 April 1975, furnished an invaluable picture of Galveston District's military activities and provided all the details regarding fortifications work that appear in this chapter.
- ³⁸ U.S. Military Academy Association of Graduates, *Assembly*, October 1954.
- ³⁹ *Ibid.*
- ⁴⁰ Pearson interview.
- ⁴¹ *Ibid.*
- ⁴² *Ibid.*
- ⁴³ M. R. Royar to author, 4 December 1975.
- ⁴⁴ Laird interview.
- ⁴⁵ Telephone interview with Darrell Jackson, 23 January 1976. Military real estate work began in 1942 out of Dallas. Part of the Southwestern Division Real Estate Office was located in Houston during the following year. In 1950, about the time the Fort Worth District was created, this Houston office was closed and moved to Galveston.
- ⁴⁶ OCE, General Order (GO) 3, 25 January 1951.
- ⁴⁷ Laird interview.
- ⁴⁸ *Ibid.*
- ⁴⁹ *Ibid.*
- ⁵⁰ Interview with Bruce Walters, 6 January 1976; Laird interview.
- ⁵¹ Pearson interview.
- ⁵² *Ibid.*
- ⁵³ Walters interview.
- ⁵⁴ Laird interview.
- ⁵⁵ W. H. White, "Thin-Shell, Precast Concrete Roof Panels Utilized in Kelly AFB Warehouse Project," *Texas Contractor* 65 (3 May 1955): 26-27; Telephone interview with Gerald Lyda, 19 December 1975.
- ⁵⁶ Lyda interview.
- ⁵⁷ OCE, GO 17, 22 May 1961; *Galveston District Organization Chart*, 1 January 1962; *Ibid.*, 1 August 1967.



The Inanimate Enemy and the Corps

A New Realm of Activity

In bringing multiple harbors to the Texas Coast and in furnishing an imposing array of defensive works and wartime services, the army engineers had only tangentially dealt with a problem that would later become a prime concern. Their few forays into the arena of flood control were conducted initially under the semblance of preserving navigable waterways or of protecting federal military installations.

The first attempt to battle the forces of floodwaters within the territory of the future Galveston District began in 1877. Frequent flooding that changed the channel and encroached upon the banks of the Rio Grande seriously jeopardized historic Fort Brown. A rather futile project, funded with an appropriation of corresponding magnitude, was initiated. Several years later, Major Mansfield inherited the protection of Fort Brown along with the other coastal projects that comprised the work of the new Galveston Engineer Office. By 1882, he had concluded that it would be more expedient to move the endangered buildings on the post than to attempt to control the Rio Grande by artificial works.¹ So much for the first federal venture into flood control in Texas. At this point, and for a great many years to come, flood control per se was not considered a proper function of the federal government.

Sweeping reforms in the twentieth century would change all that. New forces were at work, redefining governmental responsibilities and offering fresh perspectives on national resources. Gradually, progressive legislation brought a fresh crop of functions into the federal domain.

Federal policy toward flood control evolved through several formative stages, in response to three critical legislative acts. The first, passed March 1, 1917, brought the subject of flood control out into the open and asserted that it was the proper business of the national government. The effect of this legislation on the Galveston District was largely to stimulate watershed studies on some of the "navigable" rivers that ranked among the greatest flooding offenders.²

Opposite page: Flooding on Galveston's Strand after 1919 storm produces a scene only too familiar to many communities throughout Texas.

The Rivers and Harbors Act of March 3, 1925 opened the door to a broader and more integrated approach to water resources development, calling for comprehensive planning that would incorporate navigational improvements, potential power production, flood control, and irrigation needs. The Corps of Engineers responded with House Document 308, Sixty-ninth Congress, First session, setting into motion an extensive series of preliminary examinations directed toward these ends with an emphasis on feasibility of power development.³ Only one river within the Galveston District boundaries was thought at the time to have power capabilities worth exploring; accordingly, a "308 report" on the Guadalupe River was prepared.

The real milestone in flood-control policy was reached with passage of the Flood Control Act of June 22, 1936, which declared:

. . . that investigations and improvements of rivers and other waterways, including watersheds thereof, for flood-control purposes are in the interest of the general welfare; [and] that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.⁴

This act spelled out, in no uncertain terms, a new direction for flood-control work, not only justifying it as a proper activity of the federal government, but also extending its scope beyond the limitations of navigation. In Galveston, this legislation spurred a flurry of activity as the district viewed the many rivers and streams within its boundaries in a different light.

During the years between 1936 and 1941, the Galveston District conducted flood-control studies on sixteen river systems, including all the major rivers in Texas plus Santa Isabel Creek, the Pecos River, the Rio Grande in Colorado and New Mexico, and the Mimbres River in New Mexico. The tremendous increase in the volume of work sparked expansion of the district, producing an influx of personnel that included many engineers who remained to become mainstays in the Galveston District.

Boundary changes occurred also as flood-control work was taken up by the army engineers. Temporarily, the Brazos River above Washington was transferred in 1936 to the short-lived Mineral Wells District, only to be reincorporated into the Galveston District by September of the following year. With formation of the Albuquerque District late in 1941, reassignment of responsibility for drainage basins of the Pecos River and of



Houston city waterworks pumping plant submerged by 1935 flood

Help for the City of Houston

The first project was generated by a deluge in Houston that occurred December 6-8, 1935. Memories of another bad flood during May 24-31, 1929 still lingered in the minds of Houstonians. With a rainfall averaging 11.7 inches for the watershed, the 1935 storm produced an overflow of Buffalo Bayou and its tributaries resulting in loss of eight lives, damage in the city amounting to \$2.5 million, and increased currents along with silting in the Houston Ship Channel that restricted navigation for three days.⁶

Soon to become one of the fastest-growing cities in the country, Houston loomed as a superb candidate for even more devastation from floods. In its original state, the relatively flat terrain provided only low slopes to facilitate runoff following a rain. This limitation, coupled with the impervious clay strata characteristic of the watershed, made for slow drainage even before the settlement and urbanization of Houston began. Manifestations of the ensuing problem had been noted as early as 1835:

Although roads were a problem throughout Texas in wet weather, the Brazos prairie west of Houston became especially notorious . . . in bad weather much of it flooded, presenting so dismal a sight that many immigrants who intended to settle in Texas returned home after seeing it.⁷

Those stalwart pioneers, sturdy and stubborn enough to settle in Houston despite these disadvantages, planted seeds of urbanization. One hundred years later, the hallmarks of urban development — streets, highways, parking lots, and sidewalks — had seriously aggravated the situation, interfering with natural drainage by increasing the rate of runoff and, consequently, the potential of flood damage.

After the 1935 flood, Congress directed the chief of engineers to study the problem of Buffalo Bayou. Submitted by the Galveston District in April, 1937, the report of this study led to legislation in 1938 and 1939 authorizing a project to protect the city of Houston and its ship channel from the ravages of flooding.⁸ By 1940, a detailed plan had been drawn involving three detention reservoirs, channel rectification, and two diversion canals.

The term “rectification” as it is used by the army engineers refers to both straightening the channel alignment and enlarging the channel cross section to increase discharge capacity. Lining or paving the channel further serves to enhance flow capacity by reducing resistance or friction of the water against the banks, thus permitting faster runoff. Overall, the purpose is to lower the water surface in the channel.

As the project evolved under the 1940 plan, the essential ingredients actually constructed consisted of two detention dams upstream on Buffalo Bayou and rectification downstream. Barker and Addicks reservoirs were designed to control runoff from the westerly 279 square miles of the watershed. The earthen dams store large amounts of rain water and

Capitol Avenue bridge, looking upstream toward Sabine Street bridge in Houston after 1935 flood. Water has receded about 6 feet below crest.





Barker Dam construction. Placing riprap at upstream end of outlet works, September 23, 1942

regulate release of the impounded waters through gated conduits. Contract work began on Barker Dam on February 2, 1942. Completed in 1945 at a cost of \$4,530,000, this structure extends a length of 13.6 miles with a reservoir capacity of 207,000 acre-feet. Addicks Dam, begun in 1946 and completed in 1948 at a cost of \$5,248,000, is 11.6 miles long and has storage capacity of 204,500 acre-feet.⁹

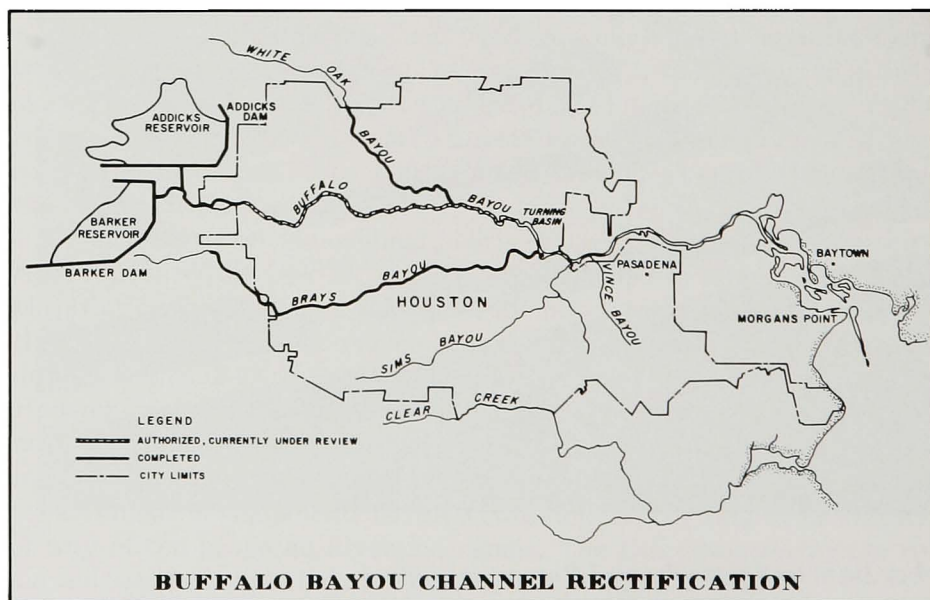
Other features of the original plan — diversion channels and a third reservoir on White Oak Bayou — were precluded by changes that took place during the war years. The tremendous industrial development along the ship channel and corresponding growth of the city, which over the decade of the 1940s represented a 54.6 percent population increase in Houston, made completion of the original flood-control plan impractical, if not impossible. The site selected for the White Oak Reservoir had been incorporated into the limits of the city and developed into a residential area. Similar developments covered considerable portions of the rights-of-way of the proposed diversion canals. The Galveston engineers returned to the drawing board to restudy the problem in 1948.¹⁰



Barker Dam outlet works and Reservoir, 1969

The problem of the Buffalo Bayou watershed did not then, and does not now, lend itself to simple solution. Initially, a "design storm" was developed from investigation of fifty-two storms that had occurred in central and coastal Texas. Serving as a measure for the magnitude of protection needed, the design storm was based largely upon a storm at Hearne in 1899 and incorporated some rainfall modifications based on a storm at Taylor in 1921. Local interests indicated they would be satisfied with protection against a lesser flood; consequently, the Corps of Engineers used the design storm for design of the reservoirs and the 1935 storm increased by 50 percent for design of the channels below the reservoirs.

By the time the engineers readdressed themselves to the Buffalo Bayou plan in 1948, more refined guidelines for project design were available. With added experience in flood control since 1940, the Corps of Engineers had developed the concepts of Standard Project Storm and Standard Project Flood. A Standard Project Storm is defined as the most severe combination of meteorological parameters considered reasonably characteristic of a particular drainage area. The Standard Project Storm for Buffalo Bayou was determined as having an average depth of 19 inches over 200 square miles in twenty-four hours. The Standard Project Flood, the runoff from the Standard Project Storm, provides a practical measure of specific flood potential. As such, it serves as a standard against which degree of protection may be judged and represents the flood discharge that should be selected as the design flood for a project.¹¹





Brays Bayou rectified channel, 1976

Once determined, any Standard Project Storm remains constant. The Standard Project Flood is variable, however, changing in relation to conditions within the watershed. Such has been the case in Houston, where the rapid rate of population growth and urban improvement has dramatically altered runoff conditions.

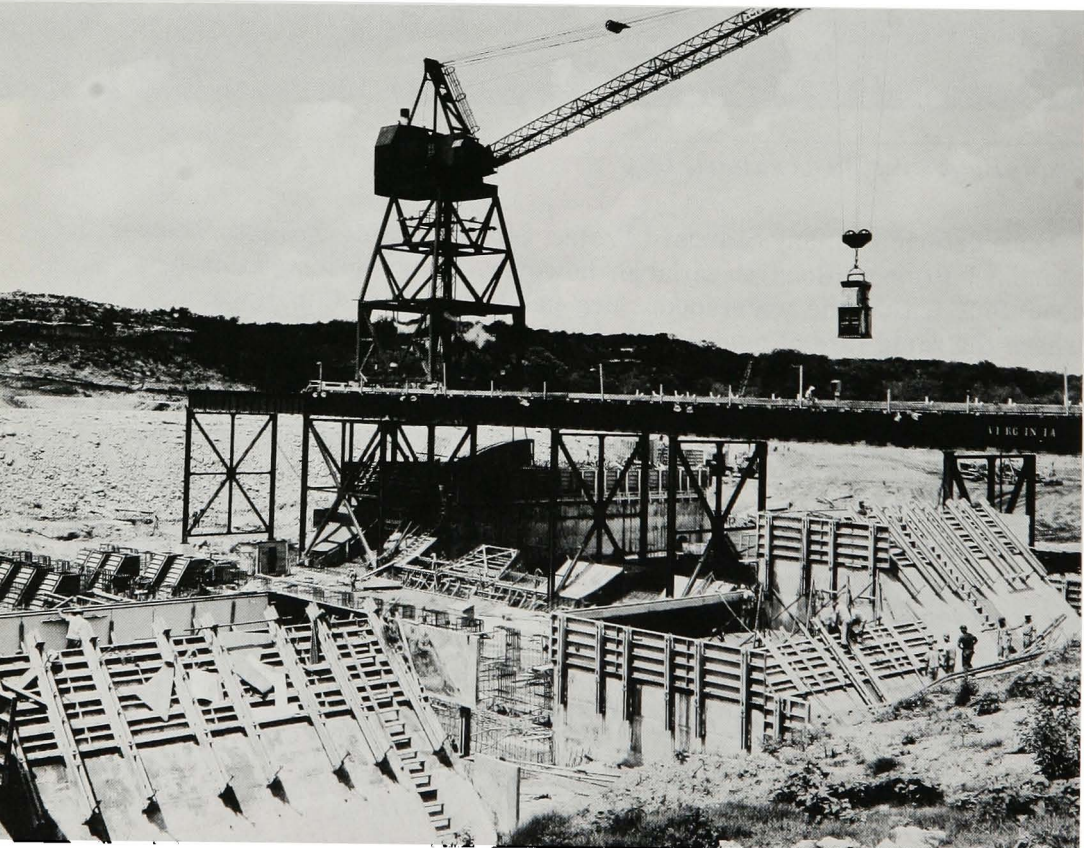
Using an updated Standard Project Flood, the Galveston engineers explored two basic plans. The plan calling for diversion of most of the floodwaters into the Brazos River watershed they rejected as infeasible on a number of counts. They settled on the alternate plan, rectification of the principal channels in the Buffalo Bayou watershed, to complete the project with sufficient capacity to carry the design flood and releases from the reservoirs across the city and into the ship channel. In 1954, Congress authorized channel work in Buffalo Bayou and two of its tributaries, Brays and White Oak bayous. An upstream extension on White Oak Bayou was authorized in 1965.¹²

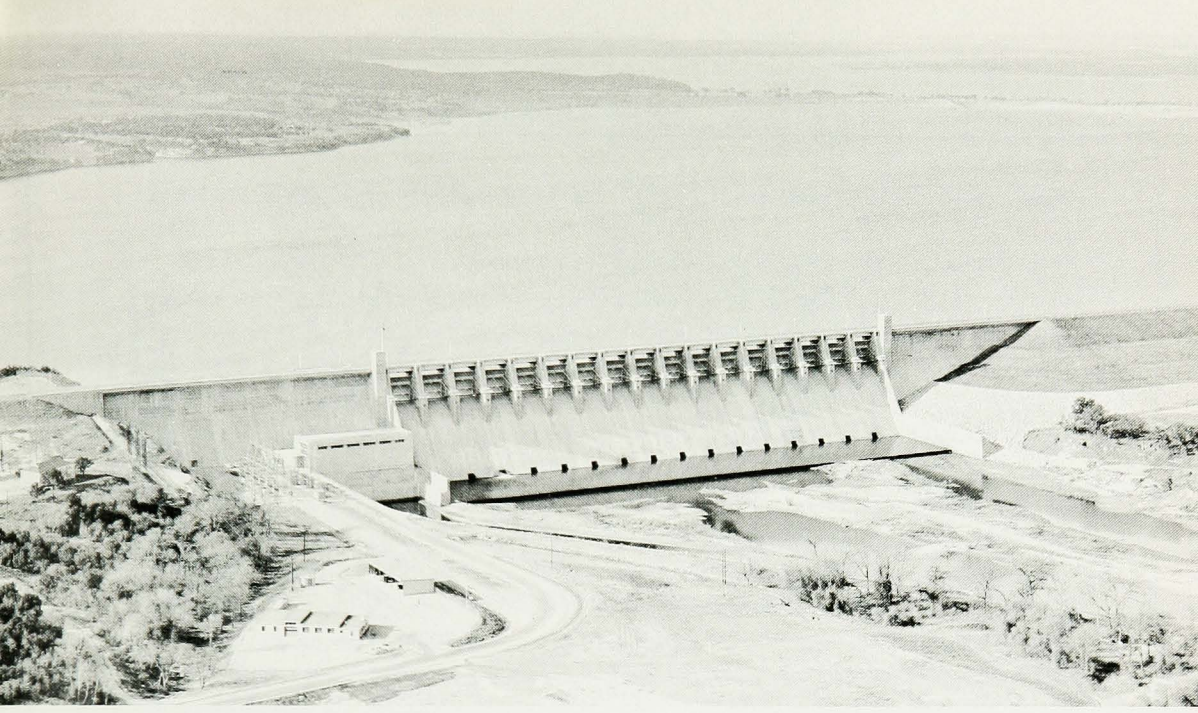
Rectification on Brays and White Oak bayous has been completed; however, only about 7 miles of discharge channel have been constructed on Buffalo Bayou below the reservoirs. Because the projected improvement downstream would involve substantial alteration of the natural state of the bayou, opposition arose which has deferred work on the project since the late 1960s. Meanwhile, the city continues to grow, the Standard Project Flood continues to increase, and the safety of the city of Houston from major flood damage remains a significant and unsolved question.

Flood Control, Fort Worth, and Flood Plain Management

The years immediately following World War II found Galveston District engineers busily engaged in flood-control projects throughout the state. By 1950, the district was working on eighteen authorized projects. Construction operations ranged from the San Angelo Dam and Reservoir on the North Concho River in West Texas, to the Whitney on the Brazos,

Whitney Dam construction, 1949. Buckets transport concrete to the forms.



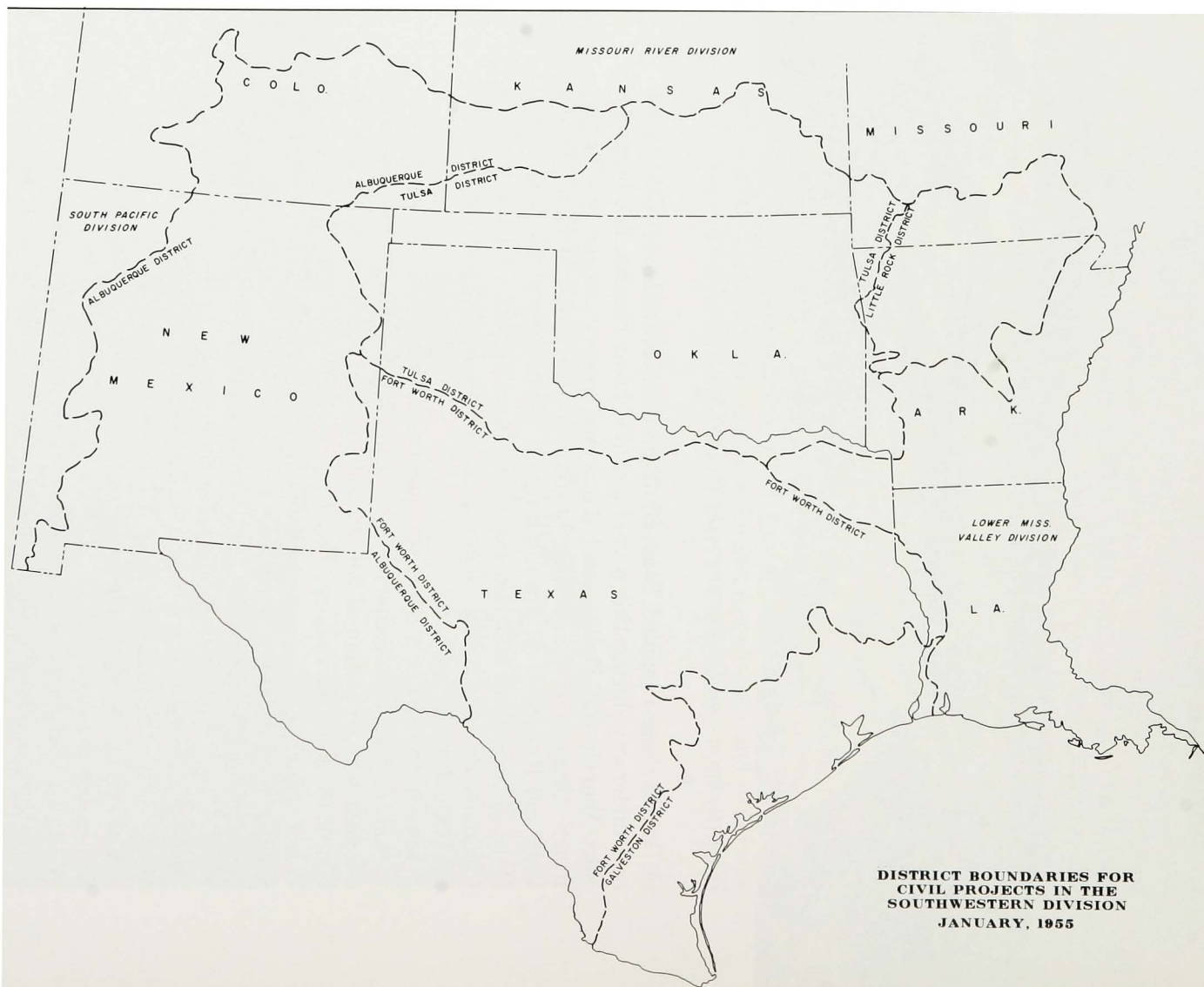


Whitney Dam and Reservoir on the Brazos River

to Dam B (later renamed Town Bluff) on the Neches River. Other projects underway during this period included levee repairs, floodways for Fort Worth and Dallas, and dams and reservoirs on the Trinity River (Grapevine, Benbrook, Lavon, and Garza-Little Elm); Belton Dam and Reservoir on the Leon River, a tributary of the Brazos; and Hords Creek Dam and Reservoir on Pecan Bayou, a tributary of the Colorado. Preconstruction planning had begun for Canyon Reservoir on the Guadalupe River.

Late in the 1940s, a move was afoot to streamline Corps operations; various organizational changes were considered. One economy measure adopted was reduction of the number of field offices, phasing out the installations at Harrisburg, Bay City, and Port Lavaca. A large Fort Worth suboffice had grown to handle projects on the Trinity River. As possible cost-cutting alternatives were being pondered, influential citizens in Fort Worth attempted to have the Galveston District moved to Fort Worth. For an uncomfortable time, the future of the Galveston District teetered precariously. Finally, on April 14, 1950, a second civil works district in Texas was established at Fort Worth.¹³

The original division of boundaries was based on function: flood control and water conservation and utilization were assigned to the new Fort Worth District; responsibility for navigation and major drainage projects along the coastal plain was retained by the Galveston District. Thus, the many flood-control projects authorized and initiated by the Galveston



DISTRICT BOUNDARIES FOR CIVIL PROJECTS IN THE SOUTHWESTERN DIVISION JANUARY, 1955

District were transferred to Fort Worth and completed under that district's jurisdiction.

By January 7, 1955, civil works boundaries for the two districts in Texas were redefined, this time on a geographic basis, restoring full functional responsibility to Galveston for all drainage basins within the coastal area extending roughly an average of 100 miles inland. Resuming its flood-control activities, the Galveston District completed works consisting of levees and channel rectification at San Diego Creek near Alice in July, 1955; at Little Cypress Bayou near Orange in April, 1956; and at Tranquitas Creek near Kingsville in October of that year. Work also began on improvement of the Lavaca River near Hallettsville, completed in September of 1960.¹⁴ Projects authorized later, which are now under construction, include diversion and rectification works for Highland Bayou to protect the cities of Hitchcock and La Marque in Galveston County, and channel rectification plus a velocity control structure to reduce erosion on Vince Bayou, a tributary of the Houston Ship Channel at Pasadena.

As the Corps gained experience in flood-control work, the limitations of structural improvement alone became apparent. Dams, levees, floodwalls, and channel rectification could not keep pace with the rapid rate of urban development in flood-prone areas. New approaches to the growing problems associated with flood plains were clearly needed.

Legislation passed in 1960 introduced a new function for the army engineers.¹⁵ Flood plain management presented an alternative to augment traditional techniques for fighting flood hazards. Rather than building structures to protect existing developments from flooding, flood plain management attempted to preserve the integrity of the flood plain by preventing construction of buildings on the river's right-of-way. For the Corps of Engineers, this meant compiling and disseminating information on floods and flood damages in vulnerable localities to help local agencies regulate land use and protect existing structures on the flood plain.

In highly developed areas such as Houston, flood plain management had limited applicability, but in less urbanized locations it offered a useful preventive approach. The Galveston District initiated flood plain management services in 1967, responding first to a request made through the Texas Water Development Board to study Dickinson Bayou in Galveston County. A Flood Plain Information Report on Dickinson Bayou was prepared and made available to the requesting agencies, Galveston County and its Water Control and Improvement District No. 1, to assist them in taking appropriate steps to reduce flood hazards and resulting damage.

In 1969, Flood Plain Management Services became a full-fledged branch in the Engineering Division of the Galveston District. To date, this

branch has completed thirty flood plain information reports. These reports generate data that serve as guidelines to the local communities requesting them. A typical report contains maps of the flooded area, flood profiles, charts, tables, photographs, and a narrative describing former floods and projecting the characteristics of those that may be expected in the future. Another service performed by the branch has been to search existing files and furnish to individuals information regarding the flood potential of their private property.

Meanwhile, federal involvement in the problems related to flooding had been growing. The National Flood Insurance Act of 1968 authorized a government-sponsored flood insurance program to be conducted under the direction of the Department of Housing and Urban Development (HUD).¹⁶ This created an additional program in the Flood Plain Management Services Branch. At the request of HUD, the army engineers study specified locales, identifying those areas subject to inundation. HUD uses this information in setting the premium rates for the federally subsidized flood insurance. Since 1969, the Galveston District has prepared fourteen flood insurance studies for the Federal Insurance Administration of HUD. At present, the district is conducting four studies in Orange County and a large-scale study of Harris County, which will result in thirty-one separate reports covering all incorporated and unincorporated areas of the county.

In large measure, the multifaceted flood plain management program has placed the Corps of Engineers in an advisory capacity to municipal governments and other public agencies. The army engineers further assist these local groups upon request by interpreting flood information pertinent to future land use, providing guidance on proper building and site planning, and evaluating the effects of urban encroachment on the flood plain. Flood plain regulations — land-use controls designed to direct flood plain development so as to lessen the damaging effects of floods — fall under the jurisdiction of state and local governments.

Protection against the Sea

With the expertise the Corps was developing in the general realm of flood control, it was not surprising that the Galveston engineers were soon called upon to furnish protection against floods generated by high tides accompanying tropical storms. These storms assault the Texas Coast with an average frequency of once every two years. The first locality to enlist Corps aid in safeguarding against hurricane flooding was highly industrialized Texas City, situated on the southwest shore of Galveston Bay.



Workmen at railroad opening of closure structure in Texas City floodwall, 1975

A preliminary examination to explore the feasibility of furnishing such protection to Texas City and vicinity was authorized in 1948. At that time, local protective works consisted of a concrete seawall extending along a portion of the bay with earth levees adjoining each end and extending inland. This existing system would not prevent storm tides higher than 5 feet from inundating the ground behind it. Further, withdrawal of ground water had caused subsidence, lowering the height of the seawall from 12.6 feet to 11 feet in some places and increasing the area's vulnerability to severe flooding. The value of residential, business, and industrial development in Texas City was estimated at about \$180 million in 1949.¹⁷

This value had escalated to \$518 million by 1956, the year Galveston County furnished assurances of local participation and the Galveston District submitted a favorable survey report to the chief of engineers. Two years later, Congress authorized a project providing for improvement of the existing seawall, concrete floodwalls through the industrial area, levees extending inland on the north and south sides of the city, drainage and closure structures, a tide and navigation opening at Moses Lake, highway ramps, and two pumping plants. Setting a precedent for future hurricane-flood protection projects, local participation consisted of 30 percent of the first cost including cost of land, easements, and rights-of-way.¹⁸

In September of 1960, the chief of engineers authorized modification of the plan, adding 1.8 miles of levee that would partially encircle and protect the city of La Marque. Taking off toward the northwest in an angle from the original project alignment, this extension became dubbed the "dogleg."¹⁹

The next significant influence on the project design intruded one year later. Hurricane Carla presented more extreme parameters than had been anticipated for the design storm that might be expected to occur once in a hundred years. Reviewing the problem of waves overtopping the levees, the army engineers raised the height of the proposed floodwalls and levees from 18 feet to 23 feet along the bay shore to thwart a new design tide of 15 feet above mean sea level. They also found that the foundation below the existing seawall was not suitable for the increased alterations required and revised the plans to provide instead levee protection about 1,500 feet seaward in Galveston Bay.²⁰

In mid-1962, the general location of the features proposed for construction was presented at a public meeting. The two hundred interested people gathered at the meeting responded favorably. A proposal made at that time suggested extending the project to include all of La Marque and Hitchcock. This proposal was reiterated in the form of a request by the Galveston County Commissioners Court at a meeting held in Hitchcock on January 8, 1963. It was studied by the Corps of Engineers and subsequently authorized by Congress in 1968. The La Marque-Hitchcock extension as planned would extend southeast along the Gulf Freeway (IH 45), turn south and then west across Jones Bay, and proceed inland to high ground near Hitchcock. In the course of protecting a larger area, it would eliminate the need for the "dogleg" levee and the pumping station at La Marque.²¹

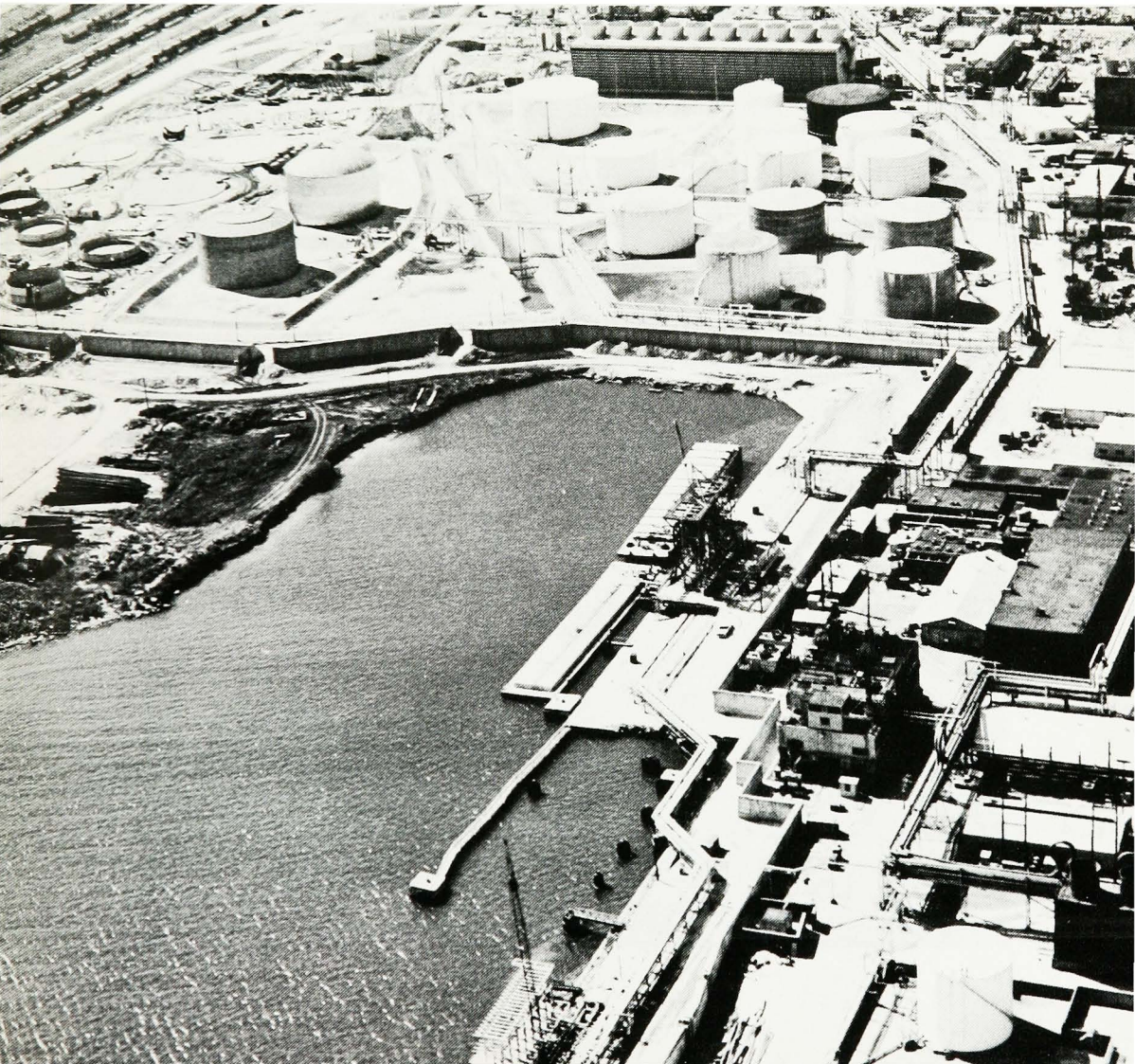
Construction of the Texas City project began in April of 1962 on the levees around Moses Lake. The tide control structure, with an overhead gate that can be lowered against a rising tide into a navigation opening, 12 feet deep by 56 feet wide, was completed in 1967; the Texas City pumping station, with a capacity of 450,000 gallons per minute, was completed in 1968.²²

Desiring protection during the interim while the enlarged project would be under construction, Galveston County built most of the length of the original dogleg levee during the early 1970s; however, this levee was constructed only to an elevation of 10 feet above mean sea level — less than the height of the authorized project design. In June, 1974, the county withdrew local sponsorship from the La Marque-Hitchcock extension because of environmental problems associated with crossing Jones Bay and blocking off marshlands.²³ This turn of events restored the permanent need for the dogleg, which will be lengthened and raised to specified

project dimensions by the Galveston District engineers, and for the La Marque pumping station which remains to be designed and constructed. These final features of the project are scheduled for completion in 1980.

Estimated to cost over \$40 million, the Texas City project will safeguard 36 square miles of valuable residential and commercial developments, petrochemical plants, oil refineries, and port and railroad terminals. The protective system stretching along 15.7 miles of earthen levees and 1.3 miles of floodwalls and closure structures will fortify this vital area against a 15-foot storm tide.

Texas City floodwall, photographed here in 1975, fortifies valuable industrial property against overflows from the harbor.



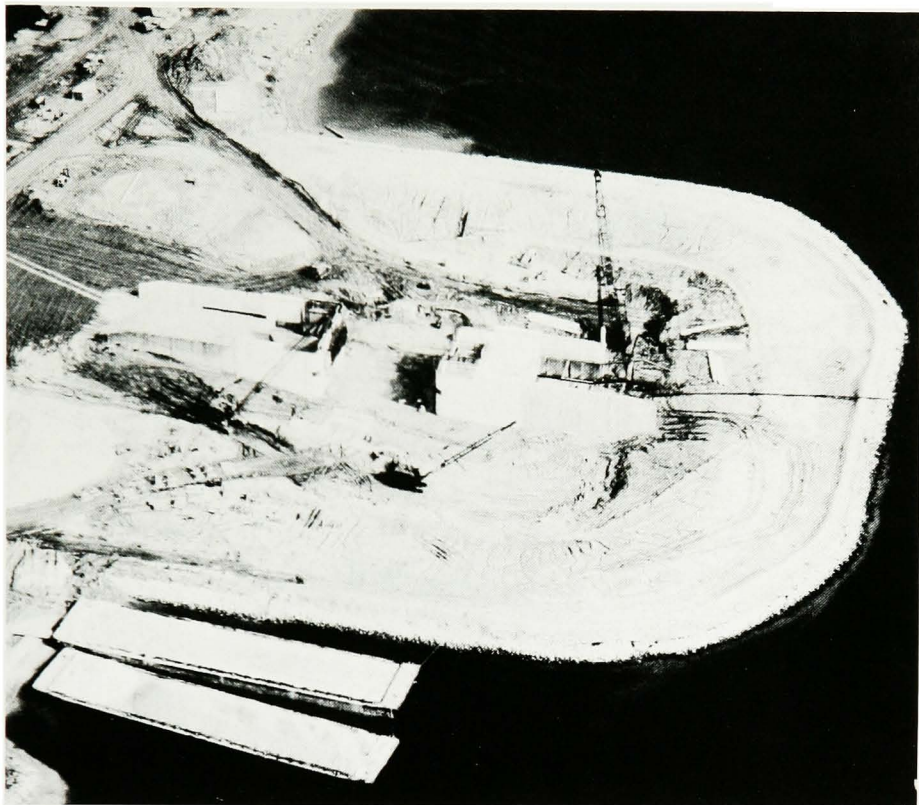
While the Texas City project was still in its infancy, the Corps of Engineers began addressing itself to the problems of hurricanes on another level. In 1955, Congress called for examination of "coastal and tidal areas of the eastern and southern United States . . . where severe damages have occurred from hurricane winds and tides." Public Law 71, enacted by the Eighty-fourth Congress, contained broad study authority for investigations into:

. . . behavior and frequency of hurricanes, . . . determination of methods of forecasting their paths and improving warning services, . . . of possible means of preventing loss of human lives and damages to property, with due consideration of the economics of proposed breakwaters, seawalls, dikes, dams, and other structures, warning services, or other measures
.....²⁴

Under this authority, the Galveston District first examined individual locations along the Texas Coast with an eye toward localized protection. These studies led to legislation in 1962 providing for hurricane-flood protection projects at Freeport and at Port Arthur.

Freeport hurricane-flood protection. Cofferdam for tidegate construction in early stages, November, 1975

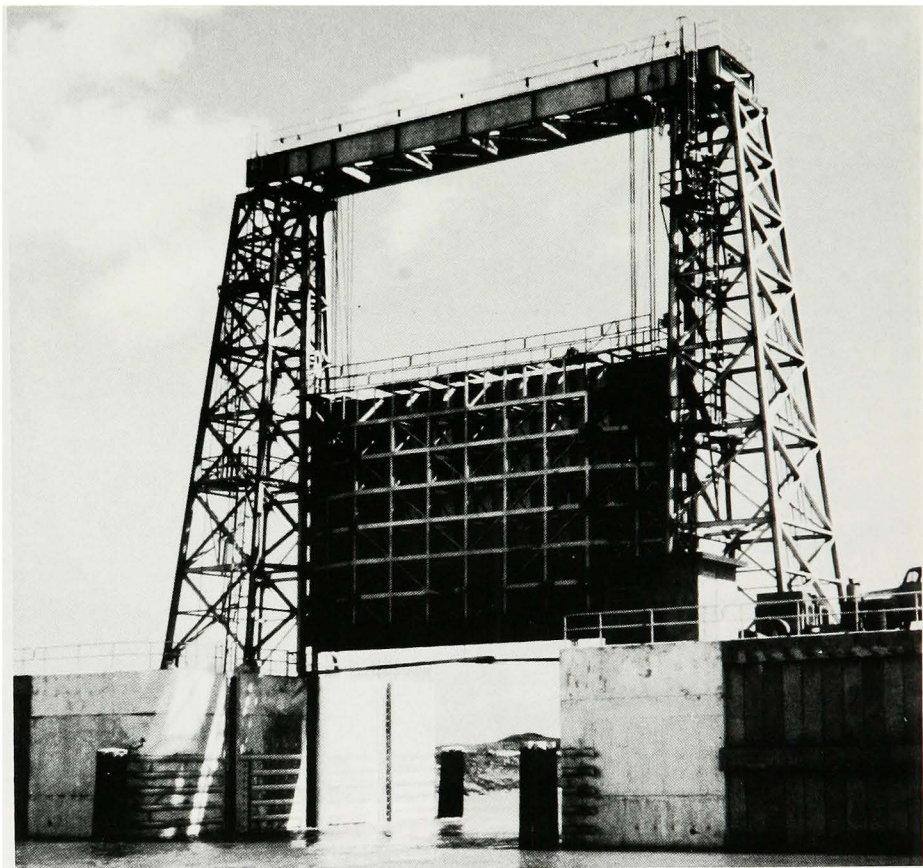




Freeport tidegate construction, December, 1976

Both areas had local levee systems, but Hurricane Carla had demonstrated their inadequacies. The newer federal projects were designed to improve and augment existing protection. At Freeport, about 42 square miles (including areas of Freeport, Velasco, Lake Jackson, Clute, Lake Barbara, and Oyster Creek) will be protected by approximately 56 miles of levees, wave barriers, floodwalls, drainage structures, pumping plants, and a vertical lift tide gate. Spanning the Old River just above the federal navigation project, this structure, slated for completion by 1978, will have a navigation opening 61.4 feet high and 75 feet wide.

At Port Arthur, approximately 60 square miles will be fortified against floodwaters by some 35 miles of protective works: 28 miles of earthen levees, 7 miles of floodwalls, vehicular and railroad closure structures, street and highway ramps, and an elaborate system to handle interior drainage consisting of gated gravity drainage structures and pumping plants. The largest of these, a pumping station to be erected on Alligator Bayou, will have a capacity of 2,250,000 gallons per minute.



Texas City tidegate at entrance to Moses Lake

Meanwhile, Hurricane Carla added impetus to the studies of coastal protection. A vastly more comprehensive investigation, known as the Texas Coast Hurricane Studies, was undertaken in 1964 in view of the fact that accelerating development along the coast was increasing potential for hurricane-flood damages faster than protection could be provided through local measures.²⁵

Still underway, these broader studies have yielded much valuable information. Identification of flood-prone areas along the entire length of the Texas coastline for storms of various frequencies has been useful for the federal insurance program and future flood plain management. The studies have generated a wealth of data regarding storm surges, waves, winds, and foundation conditions. Sophisticated mathematical models devised to estimate storm surges represent significant technical improvements in storm prediction. Concepts for design of comprehensive

structural protection and a number of plans, feasible in terms of both engineering and economic considerations, have been developed.

Through the many public meetings that have been held and speeches that have been delivered in conjunction with the coastal hurricane studies, the Galveston District hopes to have increased public awareness of flooding potential. The history of this region shows clearly the dangers of the apathy that tends to build up as intervals between storms lengthen.

A beneficial spin-off from these studies is the tide gauge network installed to collect storm data. Galveston engineers placed water level recording gauges not only along the open coast, but also in the bays and estuaries. This system allowed far more inclusive measurement than had been possible previously. Although data for the study have been obtained, forty-two gauges remain stationed along the coast, continuously monitoring tidal fluctuations. The district makes available the more complete information afforded by this network to industrial, local, state, and federal agencies for purposes of navigation, environmental conservation, boundary determinations, and special research studies.

The latest adversary in the fight against tidal flooding has advanced in the form of land subsidence, a condition resulting from heavy withdrawal of subsurface water. With removal of ground water and corresponding reduction of the water level, pressure drops between clay strata, causing the clay to release its water and become compressed, much like a sponge being squeezed. Unlike the sponge, however, the clay will not spring back to its previous dimensions and the elevation of the land above it will remain irreversibly depressed.

Recently, the problem of land subsidence has plagued many of the heavily populated and highly industrialized areas lining Galveston Bay and the Houston Ship Channel. Through its role of studying and providing protection against flooding, the Corps of Engineers has encountered subsidence as an aggravating factor, but one over which it exercises no control since subsurface water withdrawal is regulated by state and local authorities.

In 1968, the particularly acute problem in residential portions of Baytown adjoining Burnett, Crystal, and Scott bays launched the first study by the Corps of Engineers to investigate flooding specifically due to subsidence.²⁶ Geological investigations showed surface elevations in Baytown had subsided as much as 8.2 feet during the years from 1920 to 1973. If groundwater withdrawals were limited immediately, yet another 1.4 feet of subsidence would occur; if limited by the year 1980, an estimated 2.6 feet of subsidence would be anticipated. Should withdrawals continue at present rates, which cause decreased water pressures in the



Subsidence at Baytown. Rate of subsidence is striking in case of house shown above in November, 1973 and below in December, 1975.



aquifers, subsidence amounting to an additional 6.4 feet may be expected by 1995. The significance of these projections of future subsidence lies in the fact that homes now located at reasonably safe elevations will quickly become subject to disastrous flooding as subsidence continues.²⁷

To conduct this unique study, the Galveston engineers applied technical, economic, environmental, and social criteria to the various alternatives that might offer relief to the Baytown dilemma. The most feasible solution — in fact, the only feasible solution — is without precedent. It consists of a permanent evacuation plan under which 448 families, roughly 1,550 residents, in the 750-acre area comprising the fifty-year flood plain would be relocated with federal assistance provided by Public Law 91-646, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Vacated structures would be demolished and the land would be transferred to the city for uses consistent with the objective to reduce flood damage. Projected use of the land would assume conversion into a recreational area for public enjoyment and an improved habitat for birds and small animals.²⁸

Implementation of this plan remains to be seen.²⁹ Meanwhile, Galveston District engineers continue to work with these communities and others like them, ever seeking new ways to reduce losses and alleviate human suffering caused by man's age-old adversary — nature.

Notes to Chapter 8

¹ *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1882* (Washington, D.C.: Government Printing Office, 1882), p. 201 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report).

² 33 U.S.C.A. §§ 701-703 (1970); e.g., the Colorado River study in H.R. Doc. 304, 66th Cong., 1st sess. (1919).

³ Ch. 467, 43 Stat. 1186; H.R. Doc. 308, 69th Cong., 1st sess. (1926).

⁴ Ch. 688, § 1, 49 Stat. 1570.

⁵ The Mineral Wells District, established 1 April 1936 and discontinued 1 September 1937, was created specifically to construct a dam and reservoir at Possum Kingdom Bend on the Brazos. This project was turned over to the Texas Works Progress Administration on 27 August 1937, to be conducted under provisions of the Emergency Relief Act of 1935. *ARCE*, 1938, p. 893; Office of the Chief of Engineers (OCE), General Order (GO) 3, 23 March 1936; OCE, GO 11, 10 August 1937; OCE, GO 14, 23 December 1941.

⁶ H.R. Doc. 250, 83d Cong., 2d sess. (1953), p. 4; Ellsworth I. Davis, "Development of a Flood Control Plan for Houston, Tex.," *Transactions of the American Society of Civil Engineers* 118 (1953): 892 (hereafter cited as Davis, "Flood Control Plan").

⁷ Marilyn McAdams Sibley, *The Port of Houston* (Austin and London: University of Texas Press, 1968), p. 61.

⁸ Rivers and Harbors Act of June 20, 1938, ch. 535, 52 Stat. 802; Flood Control Act of August 11, 1939, ch. 699, § 32, 53 Stat. 1414, modified terms of local cooperation.

⁹ *ARCE*, 1942, p. 913; An acre-foot equals 1 acre of land covered with water 1 foot deep, or 325,850 gallons; *Reservoir Regulations Manual for Addicks and Barker Reservoirs* (Galveston: Corps of Engineers, 1962), table 1 (R 1-64).

¹⁰ H.R. Doc. 250, 83d Cong., 2d sess. (1953), p. 3; Davis, "Flood Control Plan," pp. 894-95.

¹¹ Davis, "Flood Control Plan," p. 895.

¹² *Ibid.*, pp. 897-99; Flood Control Act of September 3, 1954, ch. 1264, § 203, 68 Stat. 1248; Flood Control Act of October 27, 1965, Pub. L. No. 89-298, § 204, 79 Stat. 1073.

¹³ OCE, GO 4, 14 April 1950.

¹⁴ OCE, GO 1, 7 January 1955; *ARCE*, 1959, p. 726; *ARCE*, 1961, p. 787.

¹⁵ Flood Control Act of July 14, 1960, Pub. L. No. 86-645, §§ 206-208, 74 Stat. 480.

¹⁶ National Flood Insurance Act of August 1, 1968, Pub. L. No. 90-448, 82 Stat. 572 (codified in scattered sections of 42 U.S.C.A.).

¹⁷ Flood Control Act of June 30, 1948, ch. 771, 62 Stat. 1171; Thomas W. Anderson, "History-Progress-Future Plans for the Texas City-La Marque-Hitchcock Hurricane-Flood Protection Project" (Remarks before the Texas City Refinery Supervisors, 16 August 1973), pp. 1-3 (hereafter cited as Anderson Remarks).

¹⁸ H.R. Doc. 347, 85th Cong., 2d sess. (1958), pp. 9-10; Anderson Remarks, pp. 3-4; Flood Control Act of July 3, 1958, Pub. L. No. 85-500, 72 Stat. 297.

¹⁹ Anderson Remarks, p. 4.

²⁰ *Ibid.*, p. 5.

²¹ *Ibid.*, p. 7; Flood Control Act of August 13, 1968, Pub. L. No. 90-483, 82 Stat. 731.

²² Anderson Remarks, pp. 6, 8.

²³ *Ibid.*, p. 9; *Galveston Daily News*, 4 June 1974.

²⁴ Act of June 15, 1955, ch. 140, 69 Stat. 132.

²⁵ Chester L. Pawlik, John W. Keith, and Jack H. Armstrong, "Texas Coast Hurricane Flood Protection Studies," *Journal of the Hydraulics Division, ASCE* 93 (November 1967): 148-49.

²⁶ Flood Control Act of August 13, 1968, Pub. L. No. 90-483, 82 Stat. 731.

^{27.} *Burnett, Crystal, and Scott Bays and Vicinity, Baytown, Texas: Feasibility Report* (Galveston: Corps of Engineers, 1975), pp. 15-16.

^{28.} *Ibid.*, pp. 36, 53-61, 65.

^{29.} The Water Resources Development Act of 1976 authorized this project for Burnett, Crystal, and Scott bays.



When Disaster Strikes

The Texas Coast has been the setting for some sobering displays of the unbridled violence of natural forces. Indeed, a succession of assorted catastrophes has plagued this locale almost relentlessly. Galveston Island itself suffered one of the most dreadful calamities of this century and witnessed another at close range.

Dealing with misfortune is nothing new for the army engineers. At Galveston, their disaster activities may be traced back to the storm of September, 1875, when Engineer Department employees manned boats and rescued their co-workers stranded at Fort Point and others caught in the raging waters. They have been “on hand” for every crisis since that time, performing a role of growing importance as their special capabilities have led them into new and expanded areas of responsibility.

The most frequent and expectable natural disasters with which the Galveston District must contend are the tropical storms that besiege the coastal region during the months of June through October. One after another, these storms have swept across the Gulf of Mexico and slammed into the vulnerable Texas Coast. During the 105 years from 1871 to 1975, a total of twenty-one hurricanes struck this coastline, leaving behind a trail of destruction and devastation.¹ Because coastal residents tend to become somewhat inured to the equinoctial storms, it took a particularly bitter lesson to convince Galvestonians that major protective works were a vital prerequisite to preservation of their island.

Catastrophe Leads to Seawall Construction

As Galveston ushered in the twentieth century, this city of thirty-eight thousand residents was enjoying prosperity from its bustling port and a host of popular resort attractions. Natural sand dunes, 12 to 15 feet high, which had originally bordered the shoreline and offered some protection to the city, had been removed to allow easy access to the beach. Broadway, Galveston’s bastion of conspicuous consumption, was a spacious boulevard boasting a luxuriantly landscaped esplanade flanked by palatial mansions — architectural grandeur reflecting the substantial wealth

of the city. With an elevation of 8.7 feet above the level of the Gulf, Broadway formed the highest point on the island.²

Galvestonians were not unmindful of the need for storm protection. The subject had been tentatively broached on more than one occasion since the founding of the city. Sobered by the obliteration of Indianola on August 19, 1886, a group of thirty businessmen known as the Progressive Association met to discuss the problem and issued a public resolution calling for speedy construction of a seawall. This group obtained from the state legislature an amendment to the city charter, authorizing issuance of bonds to finance protective works; also, the association consulted Capt. James B. Eads, who submitted a plan for a 12-foot embankment. The proposed bond issue met with such widespread opposition that an election to ratify it was never held.³ The passage of time brought only apathy and inaction. E. M. Hartrick, a former city engineer who later joined the Galveston Engineer Office, offered the timely comment:

The people of Galveston will go on living in fancied security as they always have.⁴

And so they did, until the unforgettable weekend of September 8-9, 1900. With nothing more than some abortive attempts to provide protection, Galveston sat utterly undefended against the elements. By all measures a disaster of unprecedented destruction, the 1900 storm looms unmistakably as the awesome milestone in the city's history.

Preceded by a couple of days of rough waters in the Gulf and abnormally high tides, Saturday, September 8 dawned on bay waters showing a 5-foot elevation. During the morning, a gale from the north gradually pulled itself eastward and grew in intensity until, by noon, it resembled the winter "northers" in strength and direction. A slanting rain fell upon the city. Along the beachfront, brightly painted bathhouses and wooden tourist piers built out over the water became the first structural victims of the storm as the waters rose and the angry waves smashed against their pilings.⁵

By mid-afternoon, the monstrous storm was heading into its most horrendous hours. At the Weather Bureau Office in the Levy Building, the rain gauge blew away, followed sometime thereafter by the anemometer. Although no actual measurements document maximum velocity, wind speed has been estimated at 120 miles an hour. The slow rise of the tide, only a foot between 6:00 A.M. and 2:00 P.M., had been deceptive. With sudden swiftness, the waters began encroaching upon the city, soon enveloping it as the tide climbed to a height of 8.5 feet at 5:30 P.M. By this time, those unfortunate persons stranded downtown who had struck out

for their homes were literally swimming down Broadway, clutching at wrought iron fences, trees, or any other stationary objects that might prevent them from being washed away. Heroic accounts describe people riding out the storm in the upper limbs of sturdy trees and drifting through the night on floating pieces of roofs, cisterns, and other fragments of formerly intact structures. At 7:30 P.M., as the force of the wind moved towards its peak, the inundation was complete; the water had reached an elevation of 14.5 feet above mean low tide.⁶

By 10:30 P.M., the storm fury began to subside and the waters had receded to about 7 feet, but the more macabre part of the nightmare was just beginning.⁷ The devastation left in the wake of the storm was staggering. For days, the stunned survivors went about the grim business of searching through debris. Remnants of humanity were strewn across the island. On Tuesday, September 11, the *Houston Post* estimated the human toll conservatively at eighteen hundred to two thousand. The following day, the paper's banner carried the loss at five thousand lives. On September 14, the *Post* published the names of twenty-seven hundred people who had perished in the disaster. No one will ever know exactly how many lives were extinguished by the storm; although some estimates soar as high as eight thousand, the most tempered and generally accepted figure remains somewhere above six thousand.

Cut off from the rest of the outside world, the homeless and bereaved survivors faced added trials. The struggle for mere existence was complicated by lack of shelter, provisions, and suitable drinking water. Destruction of the gas works and loss of electrical power further intensified the problem. Looting broke out to an extent that necessitated placing the city under martial law.

In shock, the citizens of Galveston viewed the tragic scene that surrounded them and reckoned their losses. Property damage amounted to \$25 million. Debris from more than thirty-six hundred demolished houses blanketed the city. Destruction along the beachfront was total, the area south of Broadway having sustained the worst of the storm. In some places along the shoreline, up to 300 feet of beach had been lost by erosion.⁸

The Galveston Engineer Office suffered its share of the losses: plant was badly damaged, records were lost, and many stations used as points of reference for surveys were obliterated. After the storm, the army engineers ran a system of levels to ascertain the height of the overflow. They recorded the greatest height of the flooding, 16.4 feet, at Battery Croghan on the Fort San Jacinto reservation.⁹

Galveston citizens addressed themselves to the unfathomable task of rebuilding the shambles that lay about them. They began by revamping



Debris barrier created by Galveston storm, 1900 (Photograph by H. H. Morris)

Port side of city after 1900 storm, looking east from Fourteenth Street and Avenue A. Note scour under railroad tracks. (Photograph by H. H. Morris)





Debris dominates this view looking west from Thirteenth Street and Broadway. (Rosenberg Library)

Looking southeast from Twelfth Street and Avenue I, 1900 (Rosenberg Library)



their municipal government, introducing the city commissioner system which became known as the "Galveston Plan."¹⁰

On November 22, 1901, the new city commissioners charged a board of three engineers to plan:

- 1) The safest and most efficient way for protecting the city against overflows from the sea;
- 2) elevating, filling, and grading the avenues, streets, sidewalks, alleys, and lots of the city so as to protect it from overflow . . . , and to secure sufficient elevation for drainage and sewerage;
- 3) and, a breakwater or seawall of sufficient strength and height to prevent overflow of and damage to the city from the Gulf.¹¹

Chairing the three-man board, Brig. Gen. Henry M. Robert had been named chief of engineers on April 30, 1901 and had retired from military service on May 2 of that year.¹² This fascinating gentleman had already achieved immortality through the publication in 1876 of a slim volume, dear to the heart of every parliamentarian, entitled *Robert's Rules of Order*. His service as division engineer of the Southwest Division had occasioned numerous visits to Galveston in conjunction with river and harbor improvements and fortification construction. Also thoroughly familiar with the island, Henry Clay Ripley brought to this board engineering experience along the Texas Coast dating back to the early 1870s, when he conducted the first survey for the gabion jetties. The third member of the board was another civilian, Alfred Noble.

Submitted on January 25, 1902, the Robert Board plan called for construction of a solid concrete wall, rising 17 feet above mean low tide. This structure would extend more than 3 miles: from the south jetty near Eighth Street to Avenue D and Sixth Street, along which it would continue across the island to the Gulf, and southwest along the beach to Thirty-ninth Street. The city grade would be raised with a rise of 1 foot every 1,500 feet from the bay to the Gulf. Beginning with 8 feet at Avenue A, graduating to 10 feet at Broadway, and 12 feet at Avenue P, the elevation would culminate in an 18-foot embankment at a distance of 200 feet from the seawall.¹³

Aided by relief funds that had poured into the stricken city after the storm, Galveston County constructed this portion of the seawall between October, 1902 and July, 1904 at a cost of \$1,581,673.30. The curved concrete wall, 17,593 feet long, was erected upon a pile foundation. The design deviated from the Robert Board plan only in that the embankment



Brig. Gen. Henry Martyn Robert (National Archives)



The Galveston SeaWall when Completed

Picture of original Galveston seawall by artist Julius Stockfleth in 1904 was reproduced as a postal card. (Rosenberg Library)

behind the wall was built to a maximum height of 16.6 feet with a width of 100 feet.¹⁴ In other words, the county embankment sloped down from the seawall rather than rising up above it as the board had specified.

A seawall of similar design was authorized by Congress to protect the federal investment in the port and in the military reservation at Fort Crockett. So that the original county seawall and the new Fort Crockett extension might furnish continuous protection along the Gulf from Sixth to Fifty-third streets, the private and city property lying between Thirty-ninth and Forty-fifth streets was deeded to the United States. The Fort Crockett seawall extension, 4,935 feet long, was constructed between December, 1904 and October, 1905 at a cost to the United States of \$295,077. In all, the sum of \$750,000 was appropriated to finance seawall construction and filling the enlarged reservation up to a grade of 18 feet.¹⁵

The first test of the seawall, a hurricane on July 21, 1909, served as an object lesson for Galveston County. Although storm tides rose only about 6.6 feet above mean low tide, considerable quantities of water splashed over the seawall. The modifications made by the county caused the storm waters to drain across the fill into the city rather than back into the Gulf as the Robert Board plan had intended. The county embankment suffered severe scouring; in contrast, where the 200-foot-wide embankment rose to 18 feet at Fort Crockett, the protection for the fill proved adequate. The damage sustained by the county embankment convinced the county to repair and alter its embankment along lines of the original proposal.¹⁶

A far more severe storm crossed the Texas Coast 26 miles southwest of Galveston on August 16, 1915. Greatly exceeding the seven-hour duration of flooding in the 1900 storm, the 1915 storm inundated the city for forty hours with storm tides reaching nearly 14 feet and wave crests estimated as high as 21 feet. Nevertheless, relatively few lives were lost and property damage amounted to \$4.5 million, significant contrasts to the devastation left by the 1900 storm. The seawall successfully withstood its first major trial. This concrete structure received no injury other than two small chips near Thirty-ninth Street, where the furious waves had flung a schooner over the wall, catching the anchors on its toe and pounding the vessel above into scattered fragments of hull, masts, and cargo.¹⁷

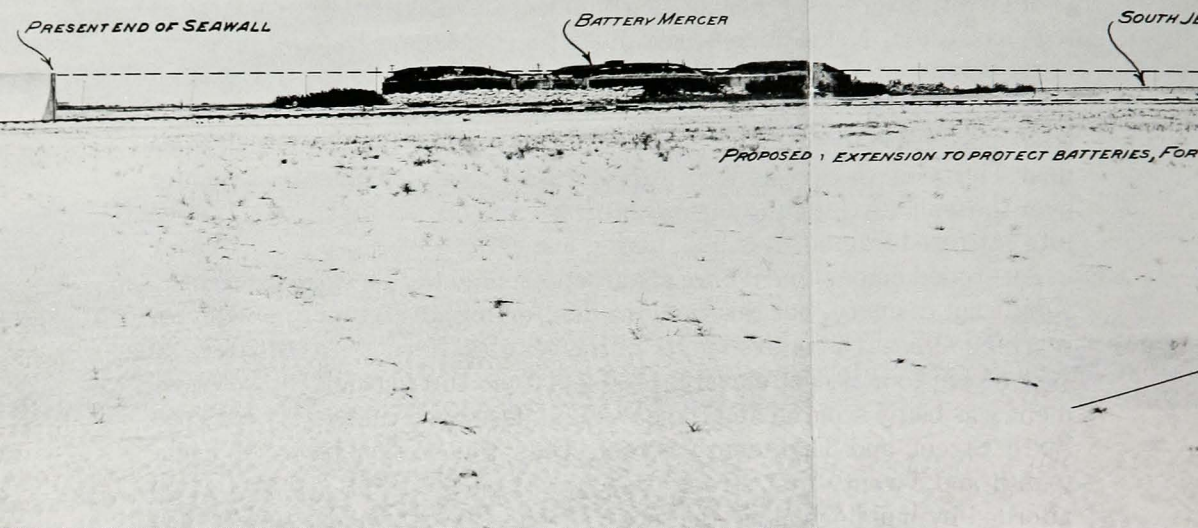
An eroded embankment once again represented the savage storm's most significant casualty, but this time the destruction was far more extensive, reaching almost the entire length of the seawall. Reconstructed after the 1909 storm to a 19-foot elevation 200 feet from the seawall, the embankment was badly scoured and the pavement destroyed completely between Sixth Street and Eighteenth Street. Only the section between Eighteenth and Twenty-first streets was spared by the additional protection afforded by buildings along that stretch. The 1915 storm also took its toll in front of the seawall, where as much as 300 feet of beach completely disappeared.¹⁸

Galveston County asked General Robert to review the problem and devise a plan to furnish further hurricane protection. His recommendations promptly led to widening the pavement behind the seawall to 100 feet, installing at that point a reinforced concrete sheet pile cutoff wall, raising the embankment to a top elevation of 21 feet at a distance 200 feet from the seawall, and adding at the crest a smaller concrete bulkhead, 1 foot thick and 5 feet high.¹⁹

If ever a man deserved to feel a storm cloud hovered over his head, it was Lt. Col. Charles S. Riché, whose first tour of duty in Galveston had

Damage to seawall embankment at Sixth Street from 1915 storm



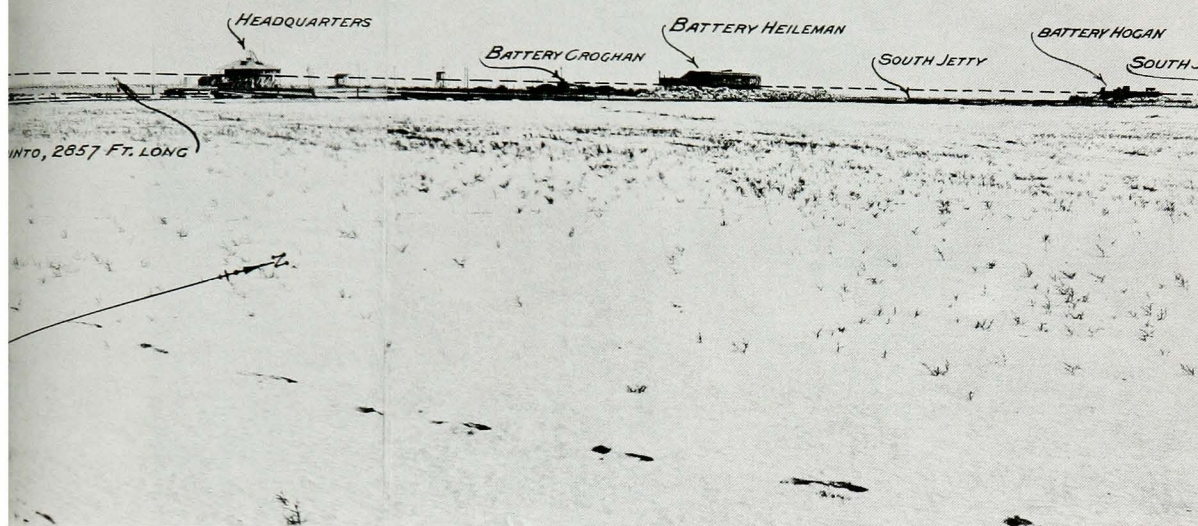


been marked by the Spanish-American War and whose second assignment there was punctuated by the 1900 disaster. During the 1915 storm, Colonel Riché occupied the helm of the Galveston District for the third and final time. After this last of the storms he would weather at Galveston, he again inspected damage inflicted upon the fortifications, channel, and harbor.

Riché found the batteries at the unprotected Fort San Jacinto structurally intact and mainly impaired by salt water that had saturated the electrical equipment. Wooden barracks and other light structures on the reservation, including the Engineer Department depot at Fort Point, were destroyed. Most alarming, however, was the fact that small channels cut up the surface of the ground in the reservation. These were particularly noticeable between the various batteries where currents had been concentrated and the scour intensified.²⁰

The 1915 storm underscored the point made by a special board of engineers early in 1913:

The special board invites attention to the advisability of protecting the narrow neck between the city of Galveston and Fort San Jacinto. It believes that in time of great storm this neck may be breached, resulting in serious damage to the Galveston Channel.²¹



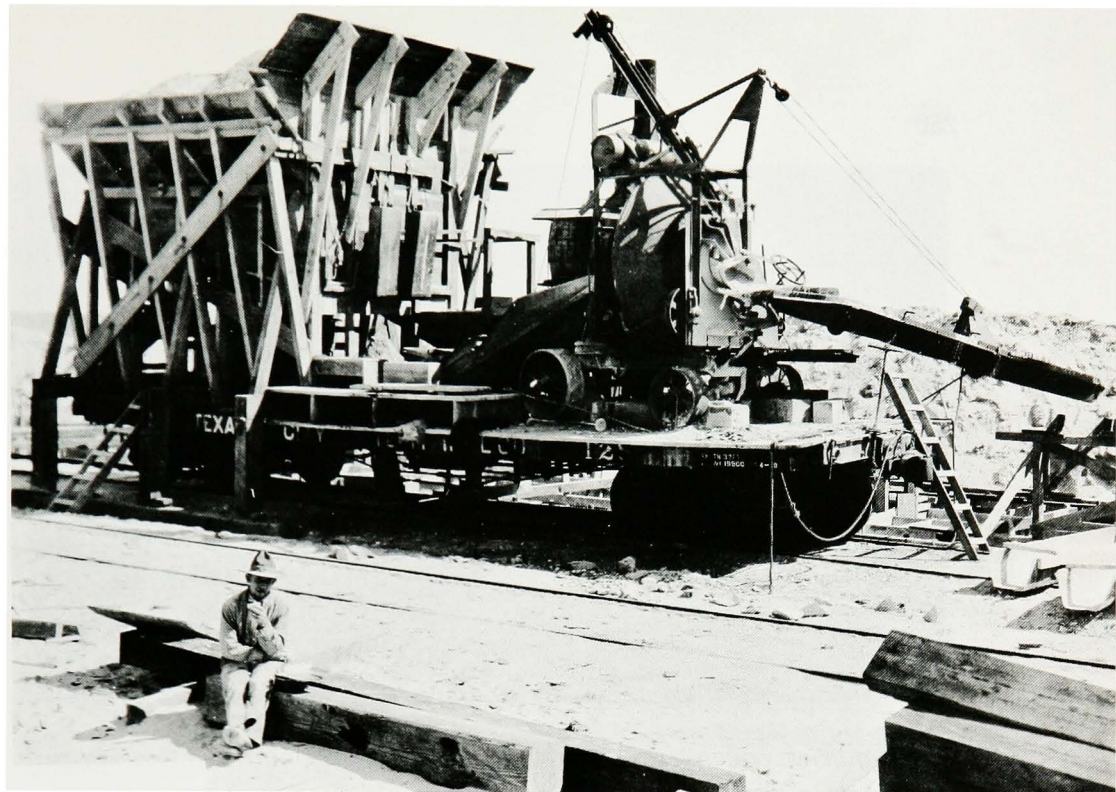
Accordingly, the Board of Engineers for Rivers and Harbors had advised building an eastern seawall extension, to stretch northeastward from the Sixth Street angle of the county structure to a point just opposite the first gun emplacement, Battery Mercer, on the Fort San Jacinto reservation. The purpose of this extension was to prevent endangering the ship channel through a possible breach in the shore arm of the south jetty, to enable wharf expansion, and to preserve the integrity of communication between the military reservation and the city. This 10,300-foot-long extension would not protect the batteries at Fort San Jacinto. These fortifications had been rebuilt after 1900 to withstand open exposure to the Gulf until such time as the seawall would be extended to the south jetty, an idea first advanced in 1902.²²

Congress responded on July 27, 1916, with authorization for the 10,300-foot-long eastward extension. Work began on June 20, 1918. The first 3,300 feet, up to the boundary of the military reservation, were built by the local interests; the remaining 7,000 feet, up to Battery Mercer, by the United States. Wartime labor and material shortages created delays. A severe hurricane on September 13-14, 1919 further interrupted progress, necessitating some refilling of the "Atlantic Hole," an old borrow pit from which material had been removed for the city grade raising and which had been scoured badly by the storm. In March, 1921, this portion of the eastern extension was completed.²³

East
round piles at
75
0

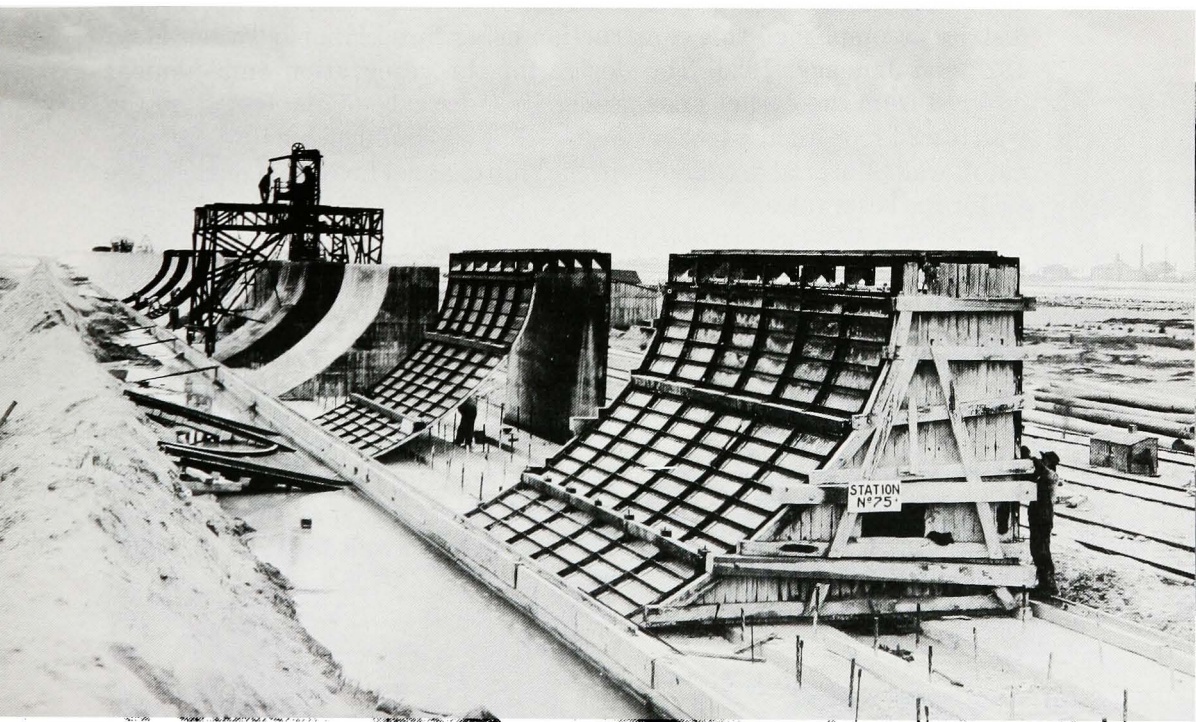


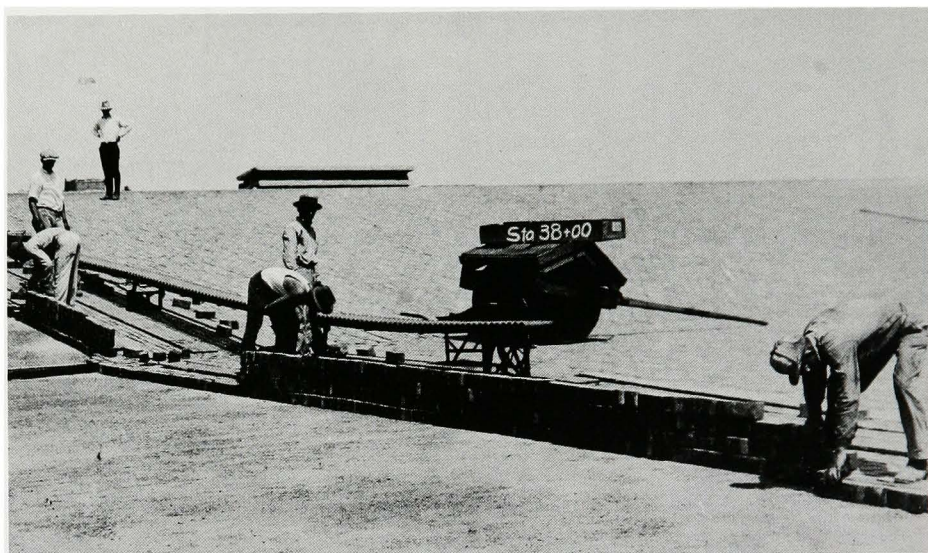
*East end seawall extension. Pile driver placing round wooden piles,
May 17, 1920*



Small concrete mixer moved along railroad tracks to pour concrete into base for east end seawall extension.

Huge steel forms, designed by Galveston District engineers, into which concrete was poured for east end seawall extension, 1920





Laying brick pavement in Fort San Jacinto portion of east end seawall extension, April 23, 1925

The 1919 storm had reiterated the hazardous plight of the San Jacinto reservation as well as the danger of not extending the seawall to the south jetty. Properly protected and filled, Fort San Jacinto would provide nearly 800 acres suitable for future military use. The final extension eastward, 2,860 feet, was authorized by Congress on September 22, 1922. Bordering the military reservation and terminating at the south jetty, the district accomplished this construction using hired labor between May, 1923 and January, 1926. The design for the reservation embankment differed from the earlier ones, rising for a distance of 100 feet from the wall to a 26-foot-high, 8-foot-wide crest that was bulkheaded by a concrete cutoff wall. Material dredged from the ship channel furnished much of the fill for the reservation.²⁴

Located at the eastern end of Galveston Island, the city had no alternative but to grow westward. Galveston County completed a 2,800-foot-long seawall extension from Fifty-third Street to Sixty-first Street in June of 1927, but city expansion continued beyond its western extremity. To protect the newly developed area, Congress authorized a 16,300-foot-long extension from Sixty-first Street west in 1950. Because the Korean Conflict delayed federal funding for this 3-mile extension, Galveston County went ahead and constructed the first mile between 1951 and 1953 at a cost of \$2,870,000. The United States began construction of the remaining 2 miles in 1958, completing the 10-mile-long seawall by 1963 at a cost of \$6,465,000.²⁵

"An Unavoidable Accident"

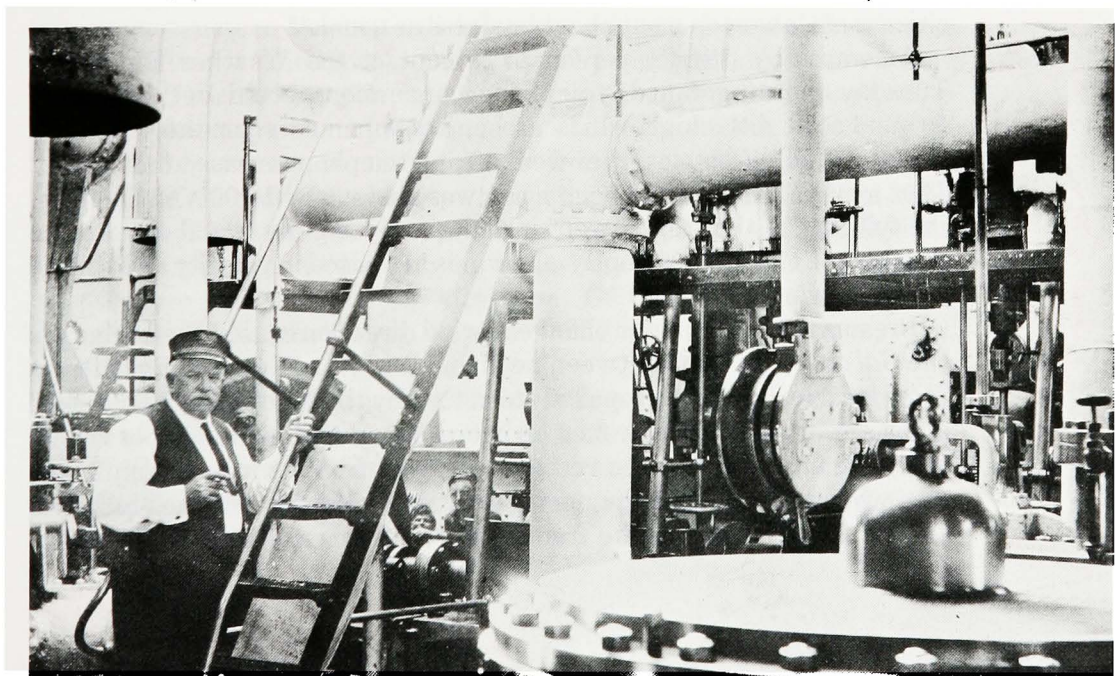
Successful in reducing storm damages on the island, the seawall still cannot eliminate such destruction altogether. One hurricane that occurred in 1943 remains a vivid memory for many Galveston District personnel. A set of unusual circumstances conspired to cause disastrous loss of lives and plant.

The storm itself was out of the ordinary, arising suddenly and not far off the coast. Wartime restrictions limited radio and telegraphic communication along the coast and censored the publication and broadcasting of weather forecasts. These conditions added up to gross underestimation of the atypical storm's intensity plus confusion, if not total ignorance, of its anticipated time of landfall.

An experienced veteran of the Galveston District, the seagoing hopper dredge *Galveston* was at work in the Galveston Entrance Channel, dredging in the vicinity of Bolivar Roads. Built at a cost of \$381,574.05, this steel-hulled vessel had been delivered to the district on November 12, 1908 and was valued at \$2.5 million in 1943.²⁶

The first advisory regarding the storm was delivered by launch to Capt. Emil Laine, master of the dredge, around mid-afternoon on Monday, July 26. Before 8:00 P.M., he had anchored his ship inside Bolivar Roads at the same place where she had ridden out the 1915 hurricane when he was

Captain Prendergast, in engine room of U.S. hopper dredge Galveston. Prendergast served as inspector for the vessel's construction and later became her first master.





Capt. Emil Laine

serving as first mate. Had he known twenty-four hours in advance that a hurricane was in the offing packing winds of at least 104 miles per hour, he might have taken the vessel to the more protected waters of the Houston Ship Channel; however, for a storm of the magnitude predicted, "a small tropical disturbance of slight but possibly increasing intensity" with "strong winds 30 to 40 miles per hour," his precautions were appropriate.²⁷

Tuesday, July 27 dawned with no sign of malignant weather. Those Galvestonians who were aware of the advisories issued the previous day assumed the storm had hit land during the night and that the threat had passed. After a second advisory Monday afternoon predicting winds of 50 to 60 miles per hour, no further advisories had been received and the citizens of Galveston went about business as usual.²⁸

Attempts by district personnel to contact the Weather Bureau on Tuesday morning failed; telephone connections could not be made. Around 9:30 A.M., high winds arose, accompanied soon thereafter by heavy rainfall. Electric power went off and telephones ceased to function. That a miscalculation had been made was obvious by 10:00 A.M. By noon, the full fury of the storm swept inland, paralyzing the island city for the next couple of hours. Abruptly, the winds increased in velocity and shifted to an eastward course.²⁹

Presumably, the sudden change in wind direction caused the anchors of the *Galveston* to trip. Between noon and 2:00 P.M., the dredge drifted a considerable distance, propelled stern first by the high wind, heavy seas, and a strong ebb tide. The men on board, hampered by negligible visibility, were unaware that the vessel had moved from its mooring until 2:45 P.M. when they sighted the north jetty about 150 feet off the starboard side of the dredge. Despite frantic efforts to steer clear, the *Galveston*

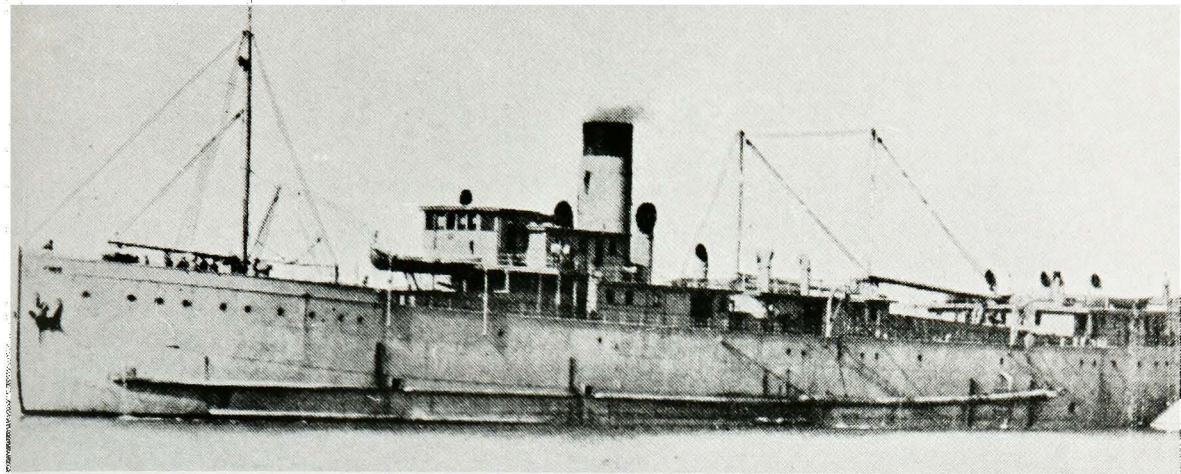


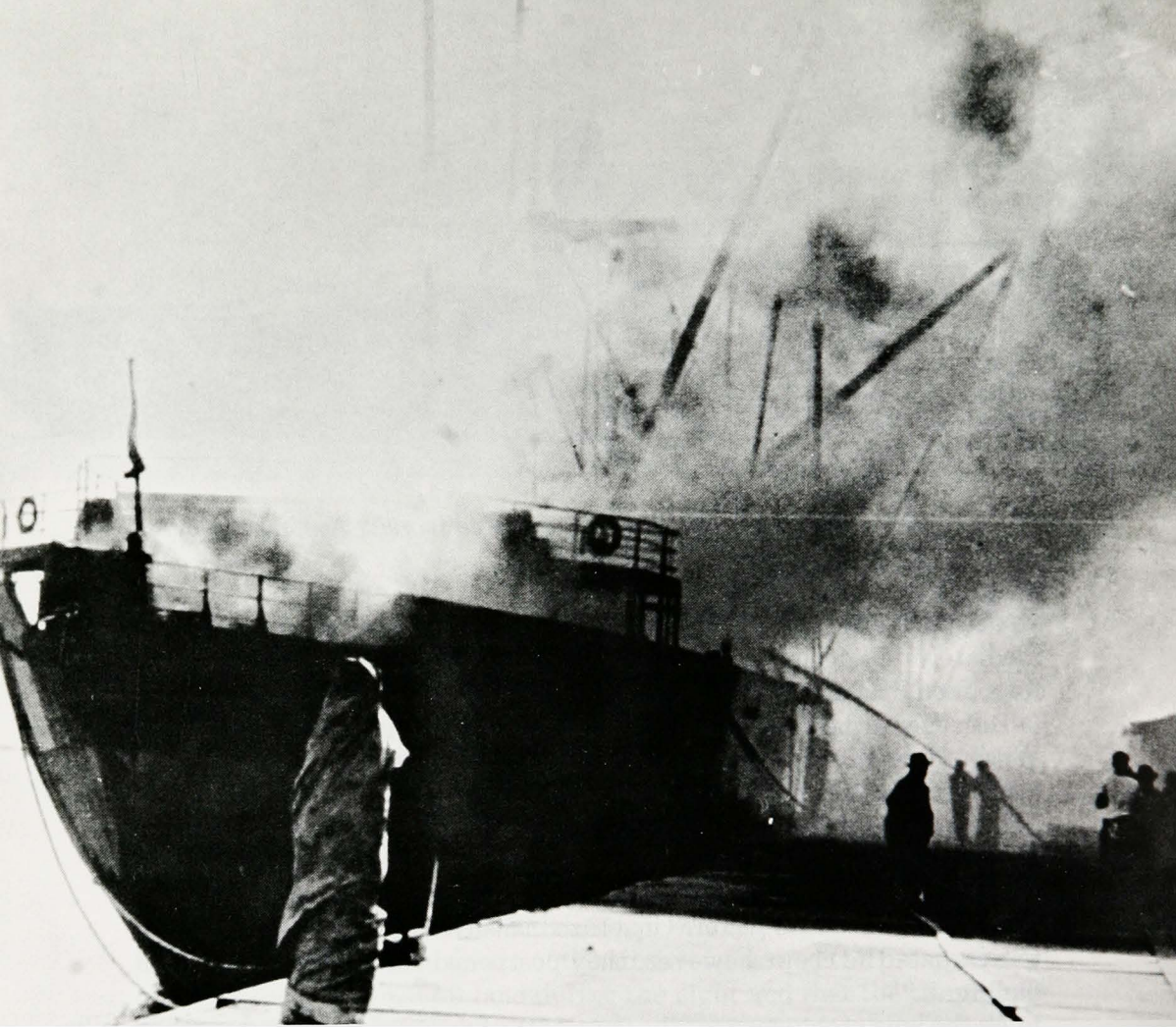
Plate of new dredge Galveston as she appeared in 1909 Annual Report of the Chief of Engineers

struck the rocks about five minutes later, puncturing her hull and immediately taking in water. Crew members moved up to the top deck for safety.³⁰

Because of the interrupted telephone service, District Engineer Col. Wilson G. Saville did not learn of the wreck until 8:30 P.M. on Tuesday. He arranged with the Coast Guard to attempt to rescue the crew that night. Shortly after midnight, Colonel Saville and two other district employees, Herbert Schmidt and Basil O'Brien, arrived at the dredge. Inspecting the damaged vessel by searchlight, they found the pilot house and bridge deck intact and above water. Unable to maneuver their boat close enough to evacuate the crew, however, they postponed rescue operations until daybreak.³¹

As the long night wore on, the force of the heavy seas proved more than the dredge could withstand. Some time before 3:00 A.M. Wednesday, the superstructure began to disintegrate; all but the smokestack and the masts was washed away. Older and physically disabled crew members set off for the jetty in the only lifeboat that remained intact. The rest of the men abandoned ship on orders from the captain, following an unsuccessful attempt to secure a line from the sinking vessel to the jetty. Most of the men clung to the jetty until daybreak when they were rescued; others were cast adrift and managed to reach the Bolivar shore; one man was found clinging to the smokestack; another washed up on shore, alive, Thursday afternoon. Of the sixty crew members aboard, eleven lost their lives. Captain Laine, who could not swim, went down with his ship.³²

A board of officers appointed to investigate the sinking of the *Galveston* concluded that it was "an unavoidable accident due to an Act of God." A little after two months after the storm, the government relaxed weather data restrictions, justifying the changes on "improved defense and other war conditions."³³



French freighter Grandcamp burning at Texas City dock, just before she exploded, April 16, 1947 (AP Wirephoto, Courtesy of Galveston Daily News)

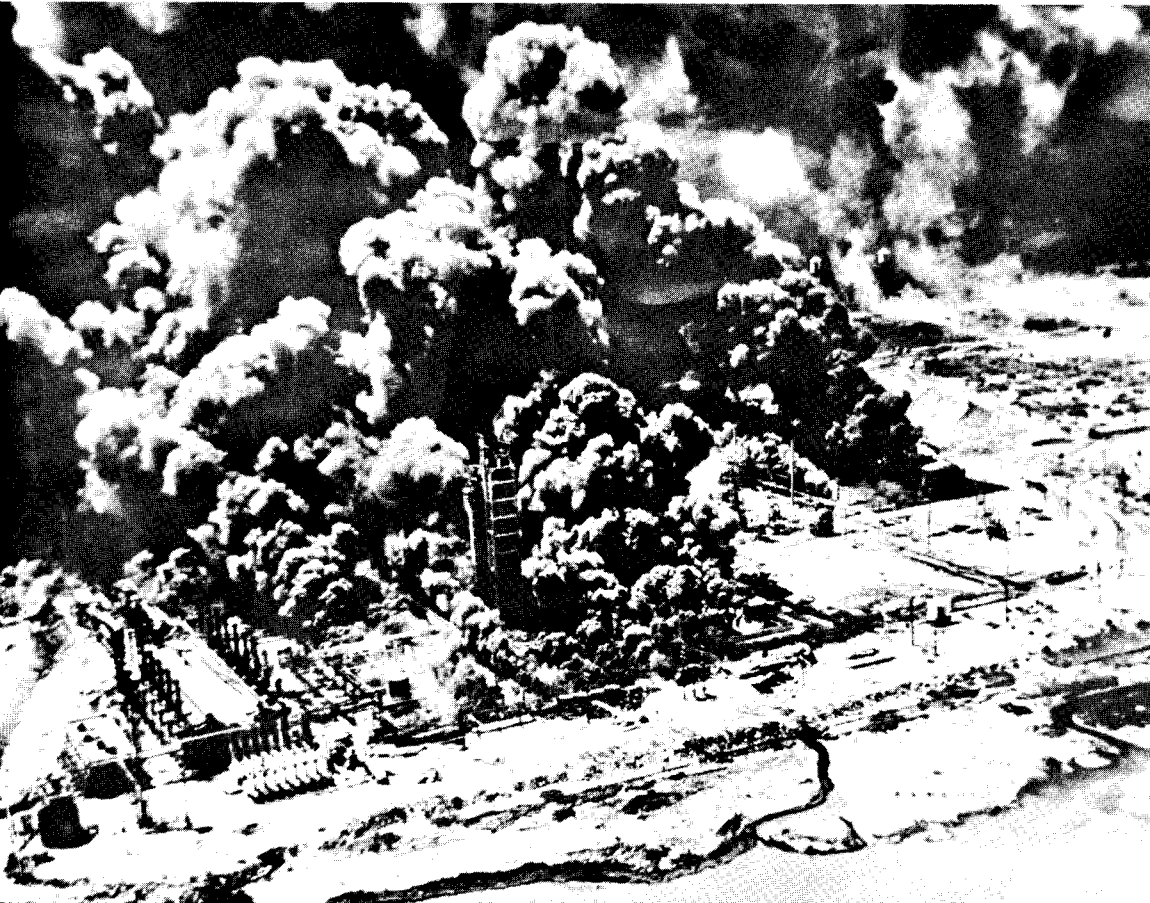
On Hand for a Holocaust

Preparedness of the Galveston engineers, conditioned by repeated experiences with hurricanes as well as wartime operations, was well demonstrated by their response to a somewhat different type of emergency. Shortly after 9:00 A.M. on April 16, 1947, a cargo containing almost twenty-four hundred tons of ammonium nitrate exploded aboard the SS *Grandcamp*, docked at Texas City. Vibrations from the explosion were so intense that personnel at the Port Arthur Area Office, 65 miles away, felt their impact. The initial blast triggered a series of further explosions in the Monsanto Chemical Company area, producing immediate havoc along the Texas City waterfront. Because of the overwhelming heat and wreckage generated by the explosion, a second ship, the SS *High Flyer*, also

loaded with ammonium nitrate, could not be removed from the dock area. At about 1:15 A.M. on April 17, this ship also exploded, adding more horror to the blazing nightmare that resulted in over five hundred deaths, thirty-five hundred injured persons, and property damage estimated between \$50 million and \$90 million.³⁴

Promptly after the first explosion, Galveston District Engineer Col. D. W. Griffiths and other engineer personnel set out aboard two launches for the scene of the disaster. Still other personnel from the repair yard and plant facilities at Fort Point sped toward the mainland by automobile. They reached the City Hall at Texas City by 10:00 A.M. and immediately set up radio communication through a mobile radio unit. Shortly thereafter, Colonel Griffiths and his staff landed at the Texas City Dike, "requisitioned transportation from a passing motorist," and arrived at the City Hall to organize relief operations. Griffiths contacted the commanding officer at Fort Crockett, reporting the seriousness

Explosions set industrial area ablaze. (Courtesy of Galveston Daily News)





Texas City evacuated except for rescue and relief workers. Burning industrial area in background, April 17, 1947 (AP Wirephoto, Courtesy of Galveston Daily News)

of the disaster and making an urgent appeal for medical aid from the Fourth Army.

From noon until 4:00 P.M., all available pickup and carryall trucks, loaded with fire-fighting equipment, first-aid supplies, blankets, mattresses, and sheets, were used for relief activities. Corps personnel were assigned many duties including removing the dead and injured, operating motor pool vehicles for emergency transportation within the Texas City area, and setting up kitchens and feeding fire fighters and evacuation crews when the Fourth Army field kitchens arrived unmanned. Throughout the duration of the daylight hours, the launches *Ralph Millis*, *Guyver*, and *Galvez* and the tug *Wilcox* patrolled the water searching for injured and dead victims of the fire.

Late in the afternoon of April 16, Gen. Jonathan M. Wainwright, commanding general of the Fourth Army, arrived in Galveston and placed the Fourth Army relief services at the disposal of local civil authorities. Fourth Army emergency headquarters were established at Fort Crockett at 4:00 P.M., after which Galveston District personnel continued relief activities under the direction of the Fourth Army and local authorities.

On April 17, the second day of the holocaust, sporadic ignition of oil tanks compounded the confusion. Galveston army engineers made fathometer surveys in the Texas City turning basin and channel in anticipation of the tremendous task, yet to come, of clearing the debris from the channels. District personnel maintained radio communication and held in readiness land and water transportation facilities to dispatch supplies and equipment, continuing rescue and relief activities until April 23. Operations to restore the waterway for navigation were carried on through the following months.



Raising freighter Wilson B. Keene, completely demolished by explosion from a nearby boat early April 17, 1947

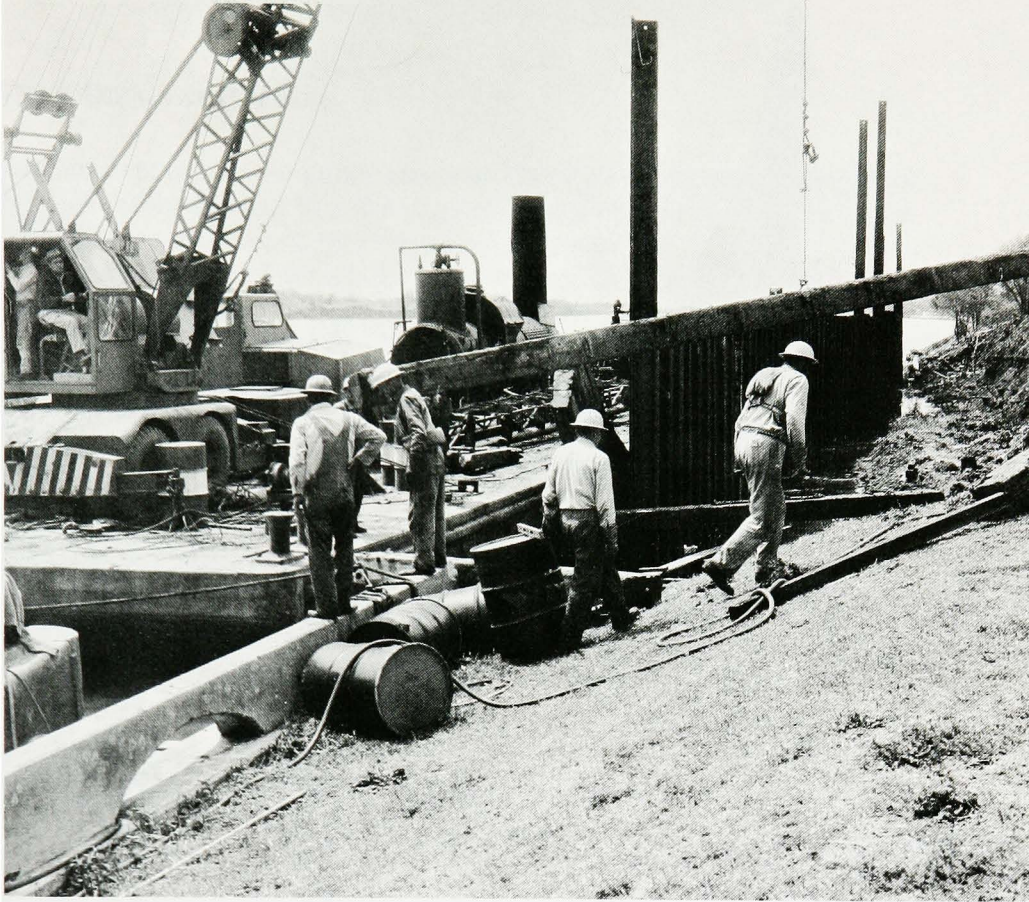
Hurricane Operations

Whenever dangerous storms have been imminent, the Galveston District has mobilized automatically. Engineer personnel have routinely secured government plant, protected federal works, and taken necessary measures to save human lives and reduce loss of property. Also, they have provided valuable documentation of each storm's distinguishing features, measuring and reporting storm tides, high-water elevations, and other pertinent hydrologic and meteorologic data. Because each storm is unique, variables such as height of the storm surges, wind velocities, amounts of rainfall, spawning of tornadoes, and size and path of the cyclone significantly determine the extent and type of damage that will result.

Corps activities in the face of severe flooding and coastal hurricanes have been gradually formalized through a succession of legislative acts. Explicit authority to carry out "rescue work" and to repair "any flood-control work threatened or destroyed by flood" was contained in the Flood Control Act of 1941.³⁵ Under this and subsequent legislation, the Galveston District undertook emergency levee repairs along flood-prone streams such as the Trinity. This activity diminished somewhat after establishment of the Fort Worth District in 1950.

The 1941 act was amended several times, but essentially it limited army engineer activities to rescue operations during a storm and repair work afterwards. An amendment passed in 1955, however, significantly expanded Corps functions and responsibilities as they applied to flood emergencies. Public Law 99, enacted by the Eighty-fourth Congress, provided authority for the army engineers to conduct operations on a broader scale, adding to their existing responsibilities flood emergency preparation and flood fighting. This meant the district no longer had to wait until a disaster struck before it could take corrective or remedial action. An amendment passed in 1962 further extended authority to encompass federally authorized hurricane or shore protection.³⁶

Another legislative movement ran somewhat parallel to the evolution of Public Law 84-99, but carried different implications for the disaster operations of the Corps of Engineers. Ushered in during 1950, a national program made available federal assistance to disaster-stricken areas under Public Law 875, enacted by the Eighty-first Congress. The president was empowered to coordinate and direct the resources of federal agencies such as the Corps when local and state governments sought federal assistance. Under the provisions of the program, which has been updated by the Federal Disaster Relief Act of 1974, the Corps has been called upon to take emergency protective measures; to carry out



Emergency repairs to seawall at Port Arthur

emergency repair or replacement of dikes, levees, irrigation works, and drainage facilities; to clear debris and wreckage; to restore public facilities; and to attend to permanent restoration of flood-control works.³⁷ Technical assistance from the Corps has normally involved surveying the disaster area and furnishing reports and recommendations to the coordinating agency.

Since the mid-1950s, when the Weather Bureau began assigning female names to tropical hurricanes, several especially "lethal ladies" have visited the Texas Coast. In each case, the Corps has carried out the emergency flood-fighting functions authorized under Public Law 84-99 and has been called upon to furnish disaster relief assistance under Public Law 81-875 and its successor, Public Law 93-288.

Hurricane Carla grew out of an area of showers first noted in the western Caribbean on Sunday, September 3, 1961. A "superstorm" by most standards, Carla gradually intensified throughout the next week, until its wind circulation filled the entire Gulf of Mexico. Galveston District personnel were alerted to the large and menacing storm building up and moving across the Gulf. Continuous liaison was established with the



Waves smash into Galveston seawall during Hurricane Carla, September, 1961.

Weather Bureau, the army engineers providing support in tracking and studying the progress of the approaching monster.³⁸

On Saturday, September 9, as hurricane warnings were hoisted along the Texas and Louisiana coastline, the district established a twenty-four-hour operations center on the third floor of the Galveston Post Office Building and placed its radio-telephone network in operation. Hourly reports from coastal field offices were transmitted to the Weather Bureau. As the tides began to rise, district vehicles were moved to the higher Gulf side of the island for safety.³⁹

By Sunday, rising water covered the bay side of the island, severing the highway link to the Texas mainland and isolating the Post Office Building. After the remote control on its tide gauge in Galveston Channel was broken, the Weather Bureau used readings from the Corps of Engineers tide gauge at Fort Point. When this tide gauge went out also, district

personnel set up an emergency gauge at Fort Point and reported readings to the Weather Bureau by radio. Commercial power failed and the Corps radio net was maintained by emergency generators.⁴⁰

Carla moved inland across the coast at Pass Cavallo about 3:00 P.M. on Monday, September 11. The eye of the tremendous storm spread 30 to 40 miles in diameter. While the Matagorda Bay area near Port O'Connor received the brunt of the storm with sustained winds of 153 miles per hour, gusts estimated up to 170 miles per hour, and storm surge elevations as high as 22 feet, the hurricane force winds radiated outward about 120 miles from the center. The storm was felt from the Rio Grande to Grand Island, Louisiana, with the stretch from Corpus Christi to the Sabine River suffering destruction by hurricane winds and abnormally high water levels. Early Tuesday morning, as district personnel were rescuing victims and transporting them to local hospitals, several tornadoes spun across Galveston Island, accounting for seven deaths and damaging or destroying 389 structures.⁴¹

During the four-day period from September 9-12, Galveston recorded a cumulative rainfall of 15.32 inches. Carla caused tides exceeding 20 feet in coastal bays, inundated 1,700,000 acres of coastal land, and disrupted normal activities in thirty-eight counties for four days. Damage tolls mounted to \$408 million. Deaths from the storm totaled only thirty-two, largely due to the mass exodus of more than three-hundred thousand coastal residents.⁴²

As the deadly storm began to dissipate, the Corps of Engineers organized and sent six hydrological survey teams and eleven damage survey teams into the stricken area. They completed their surveys in thirty days, canvassing 970 communities and traveling an aggregate distance of 45,000 miles. Meanwhile, district personnel inspected government equipment and facilities and all navigable waterways. Restoration of flood-control structures and various recovery operations were performed in accordance with the laws covering floods and disaster situations.⁴³

The next major hurricane struck the southern tip of Texas on September 20, 1967, thirteen days after the first advisory had been issued. Moving inland, Hurricane Beulah was accompanied by torrential rains and 115 tornadoes, a staggering increase over Carla's record of 26 in 1961. Enormous amounts of rain caused flooding in every stream from the Lavaca River Basin to the Rio Grande Basin, accounting for the greatest proportion of Beulah's damages. Streams which normally have little or no flow became rampaging rivers. Beulah left a reported forty-four persons dead and thousands homeless, disrupting transportation, communication, and utility service throughout South Texas for weeks. Twenty-nine counties comprised the disaster area declared by the president.⁴⁴

In addition to the hurricane-related duties that had become routine for the Galveston District, Corps personnel directed their major relief and recovery efforts after Beulah toward debris clearance, health and protective measures such as removing ponded water, and restoration of dikes and levees. They also furnished technical advice, preparing damage estimates and conducting final inspections of damaged public facilities restored under contracts for the Office of Emergency Planning (OEP).⁴⁵

Col. Nolan C. Rhodes arrived in Galveston to assume the post of district engineer on August 1, 1970. He barely had time to unpack his suitcase before he was rudely initiated into operations for Hurricane Celia, which moved inland just north of Corpus Christi on the afternoon of August 3. Celia's distinguishing feature, savage winds with gusts estimated as high as 180 miles per hour, caused the major portion of destruction. The aftermath of the storm resembled more the effects of a tornado than of a hurricane. Thirteen lives were lost during this vicious storm and the metropolitan area of Corpus Christi suffered the greatest damages.⁴⁶

Producing the largest amount of property damage of any storm to date — \$467,311,000 worth — Hurricane Celia set the stage for extensive recovery activities by the army engineers. Called upon to direct a tremendous debris removal operation, they awarded the first contract providing for clearance of debris and broken glass in the downtown area of Corpus Christi on August 5, less than twenty-four hours after the disaster area was declared. Celia's devastation was so enormous that commercial activity could not be restored for six days.⁴⁷

Within a week, all seven counties in the disaster area were under contract for removal of debris from streets, alleys, and other public property. On August 26, this operation reached its peak with 1,556 contractor personnel using 195 loaders and 785 trucks moving a total of 128,000 cubic yards. Three weeks after the storm, debris clearance from private property began.⁴⁸

At the request of local authorities, the Corps of Engineers inspected many hazardous structures, recommending to OEP 1,061 demolition permits. Of these, OEP approved 938 which the engineers processed into forty demolition contracts.⁴⁹

Less than three months later, on October 21, 1970, all debris removal operations were completed and the Corpus Christi Disaster Area Office was closed. This massive cleanup operation conducted by the Galveston District and OEP cost over \$10 million.⁵⁰

Experiences with hurricanes like Carla, Beulah, and Celia demonstrate how significantly disaster work of the army engineers has grown in recent years. Maintaining a posture of constant readiness, the Galveston District

today assumes a major responsibility for safeguarding the residents and property along its coast against both natural and “man-made” disasters.

Notes to Chapter 9

¹. Walter K. Henry, Dennis M. Driscoll, and J. Patrick McCormack, *Hurricanes on the Texas Coast* (Center for Applied Geosciences, College of Geosciences, Texas A&M University, 1975), p. 11; Definitions of hurricanes vary, generally specifying sustained wind speeds exceeding 64 to 65 knots, roughly 73 to 75 miles per hour, or more.

². John Edward Weems, *A Weekend in September* (New York: Henry Holt and Company, 1957), p. 17.

³. Herbert Molloy Mason, Jr., *Death from the Sea* (New York: Dial Press, 1972), p. 74; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 17.

⁴. Mason, *Death from the Sea*, p. 74.

⁵. H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46; Mason, *Death from the Sea*, p. 82.

⁶. H.R. Doc. 218, 83d Cong., 1st sess. (1953), p. 41; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46.

⁷. H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46.

⁸. Albert B. Davis, Jr., *Galveston's Bulwark against the Sea: History of the Galveston Seawall* (Galveston: Corps of Engineers, 1974), pp. 1-2.

⁹. H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46. Table V on p. 61 presents recorded high-water elevations for the 1900 storm.

¹⁰. The city election on September 10, 1901 was tantamount to a referendum on the new charter giving Galveston its new commission form of government. "Galveston's contribution to municipal reform . . . temporarily became the core of urban progressivism. The child of the great hurricane had grown to engulf the nation in a wave of structural change." Bradley R. Rice, "The Galveston Plan of City Government by Commission: The Birth of a Progressive Idea," *Southwestern Historical Quarterly* 78 (April 1975): 402, 408.

¹¹. Rpt., Board of Engineers to Board of Commissioners, City of Galveston, 25 January 1902, p. 1 (hereafter cited as *Robert Board Report*).

¹². *Geneses of the Corps of Engineers* (Fort Belvoir, Va.: Corps of Engineers Museum, 1966), p. 24.

¹³. *Robert Board Report*, p. 10.

¹⁴. Albert B. Davis, Jr., "History of the Galveston Seawall," in *Proceedings of Second Conference on Coastal Engineering*, ed. J. W. Johnson (Houston: Council on Wave Research, Southwest Research Institute, and Texas A&M Research Foundation, November 1951), pp. 270-72.

¹⁵. Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; Act of April 28, 1904, ch. 1762, 33 Stat. 452; Act of June 30, 1906, ch. 3914, 34 Stat. 697; *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1906* (Washington, D.C.: Government Printing Office, 1906), pp. 428, 1351.

¹⁶. Davis, "History of the Galveston Seawall," p. 272; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 49.

¹⁷. Davis, "History of the Galveston Seawall," pp. 274-75; H.R. Doc. 693, 66th Cong., 2d sess. (1920), pp. 49-52; H.R. Doc. 218, 83d Cong., 1st sess. (1953), p. 42.

¹⁸. Davis, "History of the Galveston Seawall," p. 275.

¹⁹. *Ibid.*

²⁰. H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 51.

²¹. H.R. Doc. 1390, 62d Cong., 3d sess. (1913), p. 6.

²². *Ibid.*

²³. Davis, "History of the Galveston Seawall," pp. 275-76.

²⁴. H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 29; Davis, "History of the Galveston Seawall," p. 276; The 9,860 feet of San Jacinto extension built by the United States cost the federal government \$2,289,213. H.R. Doc. 173, 81st Cong., 1st sess. (1949), p. 18.

²⁵. Davis, *Bulwark against the Sea*, pp. 18-19.

²⁶. *Report of Proceedings and Findings of Board of Officers Appointed to Investigate Sinking of U.S. Dredge "Galveston" July 27, 1943* (Galveston: U.S. Engineer Office, 1943), p. 4 (hereafter cited as *Sinking of Dredge "Galveston"*).

²⁷. *Ibid.*, pp. 5, 10, Exhibit E-7, Exhibit F.

²⁸. *Ibid.*, Exhibit F & p. 6.

²⁹. *Ibid.*, p. 6.

³⁰. *Ibid.*, pp. 6-7.

³¹. *Ibid.*, p. 7, Exhibit E-3, Exhibit E-4.

³². *Ibid.*, p. 8; Interview with Herbert Schmidt.

³³. *Sinking of Dredge "Galveston,"* p. 9; *Galveston Daily News*, 12 October 1943.

³⁴. *Reports and Correspondence on the Texas City Disaster April 16-17, 1947* (Galveston: Corps of Engineers, 1947). The account of this disaster is based on pp. 1-4 of this report.

³⁵. Flood Control Act of August 18, 1941, 33 U.S.C.A. § 701 (1970).

³⁶. Act of June 28, 1955, ch. 194, 69 Stat. 186, amending 33 U.S.C.A. § 701n (1970); Flood Control Act of October 23, 1962, Pub. L. No. 87-874, tit. II, § 206, 76 Stat. 1194, amending 33 U.S.C.A. § 701n (1970).

³⁷. Act of September 30, 1950, ch. 1125, 64 Stat. 1109; Disaster Relief Act of May 22, 1974, Pub. L. No. 93-288, 88 Stat. 143 (codified in scattered sections of 42 U.S.C.A.).

³⁸. *Report on Hurricane Carla 9-12 September 1961* (Galveston: Corps of Engineers, 1962), pp. 2, 4.

³⁹. *Ibid.*, pp. 4-5.

⁴⁰. *Ibid.*, p. 5.

⁴¹. *Ibid.*, pp. 2-3, 10; *Disaster Activities under Public Law 875, 81st Congress: Hurricane "Carla" After-Action Report* (Galveston: Corps of Engineers, 1962), p. 1-1 (hereafter cited as "*Carla*" *After-Action Report*).

⁴². *Report on Hurricane Carla*, pp. 20, ix, 3.

⁴³. *Ibid.*, p. 7; "*Carla*" *After-Action Report*.

⁴⁴. *Report on Hurricane "Beulah" 8-21 September 1967* (Galveston: Corps of Engineers, 1968), Foreword, pp. 2-5.

⁴⁵. *After-Action Report on Hurricane "Beulah" 8-21 September 1967* (Galveston: Corps of Engineers, 1968), p. 3.

⁴⁶. *Report on Hurricane "Celia" 30 July-5 August 1970* (Galveston: Corps of Engineers, 1971), Foreword.

⁴⁷. *Ibid.*, tables 3 & 4; "*After-Action Report on Hurricane 'Celia' 30 July-5 August 1970*" (Typed report, n.d.), p. 13.

⁴⁸. *Ibid.*, pp. 13, 18.

⁴⁹. *Ibid.*, p. 14.

⁵⁰. *Ibid.*, p. 20.



Reconciling Progress with Ecology

A new national consciousness flourished during the late 1960s, introducing the most recent major dimension to the work of the army engineers. An awakening, as it were, to the environment so long taken for granted, this awareness was a logical outgrowth of the country's development. Years earlier, our founding fathers took stock of America's seemingly unlimited natural resources and embarked upon a nonstop course toward economic growth and prosperity. From then on, the cause of progress enjoyed unquestioned national priority.

Gradually, populations multiplied and sprawling metropolitan areas appropriated the landscape. The precarious partnership between man and his milieu deteriorated. In exploiting the assets of nature, man too often abused them with casual abandon. Finally, a concern for ecology arose, replacing the long-standing preoccupation with progress at any price.

Natural phenomena have supplied the *raison d'être* for many civil works undertaken by the army engineers — river channels to be deepened, flood waters to be subdued, storms to be protected against, and uncontrolled energy to be harnessed into the service of mankind. But where Congress had formerly directed the Corps to utilize natural resources in pursuit of progress and safety, a new mandate would add restraints aimed at restoring and preserving ecological balance.

New Life for an Old Law

Growing demands to conserve natural resources culminated in the National Environmental Policy Act of 1969. Implemented in 1970, this legislation affected a host of well-established practices. To the Corps of Engineers, it brought further broadening of activities, expanded responsibilities and powers, and increased coordination with agencies responsible for fish and wildlife, water quality, recreation, agriculture, and public health.¹

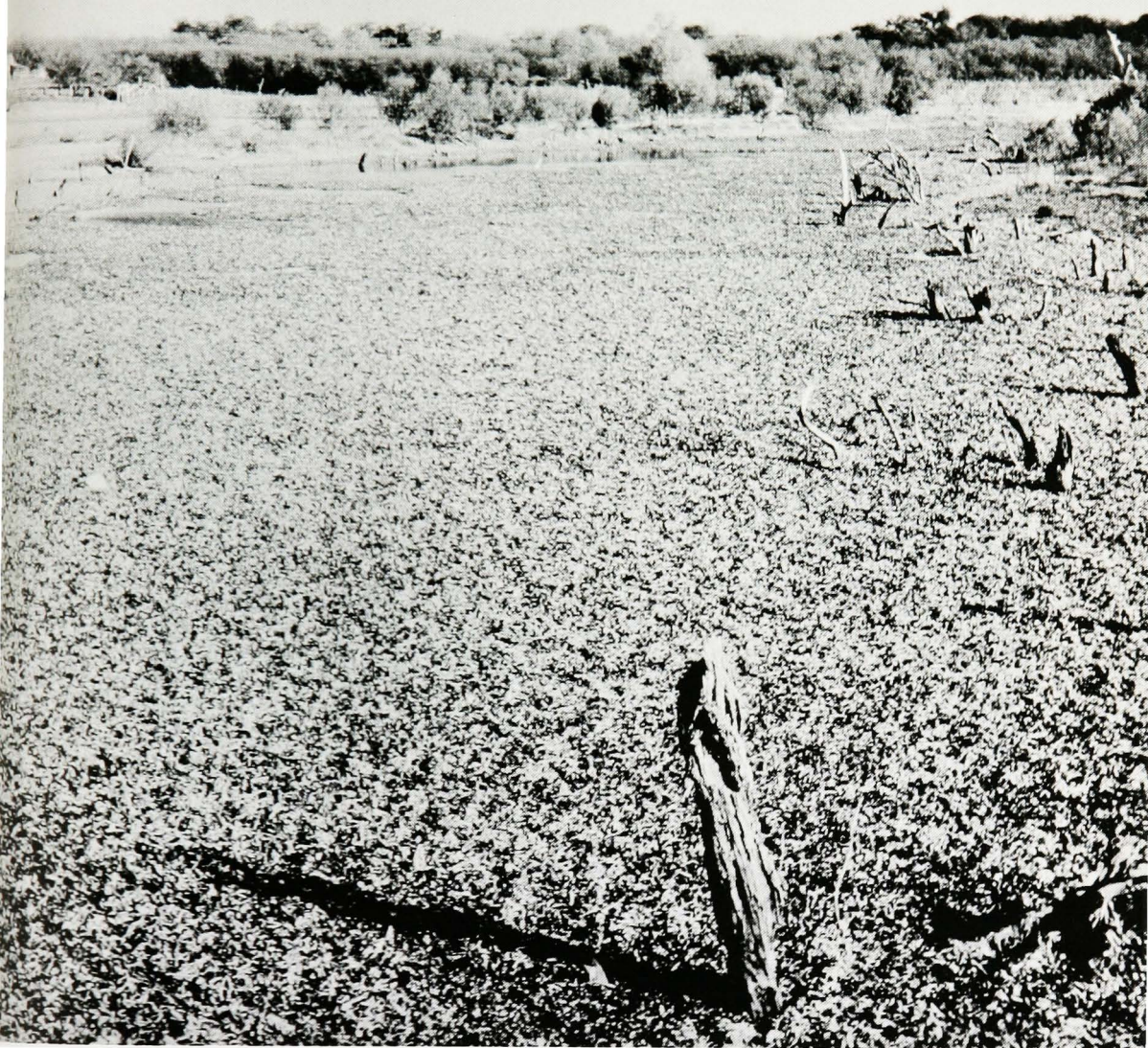
Although the Corps has been much maligned as the villain in recent environmental disputes, the historical record reveals some evidence to contradict its culpability. Indeed, the interest of the early engineers in natural resources may well be dated back to their systematic attempts to collect and classify flora and fauna during the topographical expeditions.

With their traditional responsibility for navigable waters steadily growing, the army engineers were among the first to champion the waterways during the last quarter of the nineteenth century.

The Corps was instrumental in drafting the pioneering legislation to provide protection against water pollution. The Rivers and Harbors Act of March 3, 1899 gave army engineers jurisdiction over all navigable waters and defined regulatory powers to defend the integrity of national waterways. Section 13, known as the "Refuse Act," forbade the depositing of "any refuse matter of any kind or description whatever" into these waters. More than a half century would pass, however, before the full extent of the far-reaching powers implicit in this act would become realized. A victim of narrow interpretation, the law was construed to cover only situations directly affecting navigation: structures could be built, alterations could be made, and materials could be dumped in the waterways unless they could be demonstrated to be detrimental to navigation. The burden of proof fell upon the Corps of Engineers.²

Collecting the evidence was not always enough. Clear-cut violations, such as the dumping of rice hulls into the Sabine River by a rice mill near Orange during the 1930s, could be readily shown and the offending practices halted. But more often as the years passed, water samples containing effluents or suspended particles were rejected as insufficient proof that industrial waste discharges were causing "solid" obstruction or excessive shoaling in the channels, and the violators were not prosecuted. Not until 1960 was the 1899 law given a more liberal interpretation, in keeping with the needs of the times. During the past decade and a half, this law has grown from an antipollution measure to a sweeping program of environmental control.³

The permit program sanctioned in section 10 of the 1899 law, as developed and administered by the Corps of Engineers, has safeguarded navigable waters for commercial purposes and has furnished a model for the environmental permit program developed in response to the conservation thrust of the 1960s. Enforcement powers under the Refuse Act to protect water quality were added late in 1970, when the Corps was directed to require permits for all discharges into navigable waters with the explicit objective of halting pollution of the waterways. This function was conducted by the Corps until it was transferred to the Environmental Protection Agency by the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). The most recent change in the permit program, a broadened interpretation of section 404 of the FWPCA, greatly expands Corps regulatory jurisdiction over disposal of dredged and fill material to include not only the "navigable" waterways historically under Corps control, but also adjacent wetlands, tributaries, and headwaters.⁴



Water hyacinth in winter blankets impounded waters in South Texas.

A totally different evil began threatening the waterways about the time the Refuse Act was enacted. The water hyacinth (*Eichhornia crassipes*), a showy floating plant similar to the water lily, was reputedly introduced in the United States as an ornamental at the New Orleans Cotton Exposition in 1884. Evading the confines of cultivation, this aquatic herb gradually invaded the waters of the states along the Gulf. By 1900, it had become firmly entrenched. Problems noted during 1904 in the Calcasieu, Sabine, and Neches rivers were sufficiently great to generate legislation providing for a steamboat, the *Hyacinth*, to destroy the unwelcome agent in the streams of southwest Louisiana and southeast Texas.⁵

On August 9, 1907, water hyacinths were first noticed in Buffalo Bayou.

An allotment of \$500 was made on November 4, 1907, to destroy the hyacinths and prevent their becoming an obstruction to navigation. As they were scattered in small bunches, it was deemed impracticable to spray with arsenic and soda solution, so men were employed to gather them up in boats and place them on high ground, where they dried up and died. Two men with boats and launch have been employed by the city of Houston, Tex., since February 1, 1908, on this work and have practically cleared the bayou except for a few scattered bunches in marshes and high grass below Lynchburg, Tex. This work has been supervised by the United States Engineer Department, at a cost of \$35.26.⁶

Although increased salinity, shipping activity, and concentrated pollution eventually accomplished eradication in the Houston Ship Channel, the obstinate weed continued to thrive and spread through the inland waterways across Texas.

The prolific hyacinth covers the water surface with a dense mat, capable of doubling in area every month of the growing season. Congesting or completely blanketing natural streams and drainage canals, the hyacinths adversely affect most aquatic benefits: the impenetrable growth blocks navigation, reduces discharge capacity for drainage and flood control, and restricts movement of fish; depleted oxygen content in the water and occlusion of sunlight by the broad, ovate leaves further disrupt fish and wildlife ecology, undermining basic food production and rendering the waters unsuitable for spawning purposes; finally, the plant infestations foster breeding of disease-carrying mosquitoes and preclude most swimming, boating, and fishing.⁷

Complete eradication has proved virtually impossible. Over the past seventy years, methods of controlling obnoxious aquatic plants have evolved from mechanical means such as log booms, harvesters, crushers, and saw-boats to more sophisticated chemical and biological techniques. The Corps of Engineers has undertaken research to develop safe and improved techniques to free the nation's waterways from the damaging plants. To date, a herbicide has been most effective in combatting the water hyacinth; alligator weed (*Alternanthera philoxeroides*), a vinelike plant that tends to follow hard on the heels of the hyacinth, has responded to biological treatment with the *Agasicles* flea beetle.⁸

The Galveston District is responsible for obnoxious aquatic plant control throughout the entire state. Except for Caddo Lake in northeast



Dense mat of alligator weed on Neches River, 1970s

Texas, most infested areas lie within 200 miles of the coast. A program to eliminate water hyacinth and alligator weed was begun in 1970 in cooperation with the Texas Parks and Wildlife Department.⁹ Growths of Eurasian water milfoil and hydrilla suggest potential problems that may need to be tackled in the future.

Maximizing Natural Resources

Dredging, a long-standing Corps function, has borne the brunt of much environmental criticism; in fact, this activity has proved serendipitous. Deposits of material removed from the channels have, in some instances, built up artificial islands on which marsh vegetation, capable of supporting wildlife, becomes established. A prime case in point is Brown Pelican Island in Corpus Christi Bay, where the brown pelican, an endangered species, has found sanctuary. The Galveston District controls deposition of dredged material on a seasonal basis in deference to breeding patterns of these birds. Similarly, dredging is curtailed on the Channel to Victoria so as not to disturb the winter habitat of the rare southern bald eagle. Examples of environmental enhancement afforded by the disposal islands lie all along the Gulf Intracoastal Waterway, where excavated material has created nesting grounds for roseate spoonbills, black skimmers, royal terns, great blue herons, and many other bird species. Oysters, shrimp, crabs, and other fish abound in the surrounding waters.¹⁰

Seeking to capitalize on the environmental advantages of dredged material, the Corps of Engineers has initiated a national research program to develop improved disposal techniques that will produce nutrient-

Black skimmers in West Galveston Bay. Galveston Causeway in background, 1970s





Bitter panicum grass covers barrier dune on Padre Island, September, 1974.

rich breeding and feeding grounds for marine life and waterfowl. In 1975, the Galveston District in cooperation with the Corps Waterways Experiment Station began a three-year program using dredged matter to create a 17-acre experimental marsh on Bolivar Peninsula, alongside the intra-coastal waterway. Once constructed and graded, the area will be seeded and sprigged with several types of grass. Marsh productivity, marine life and plant growth, and wildlife attracted to the marshland will be studied over a two-year period.¹¹

In an attempt to achieve engineering stability using natural materials, the district began a pilot project on San Jose Island in 1974. To counteract the persistent problem of wind erosion that has plagued this barrier island, a levee, 4,500 feet long by 1,400 feet wide, was constructed and planted with bitter panicum grass. This vegetation is expected to prevent sand displacement, reduce erosion, and preserve slope integrity.

Still other Corps projects, not originally devised for their environmental value, have yielded significant ecological and recreational dividends. The Texas City Dike, authorized as a pile construction in the 1913 navigation project and replaced in its present rubble-mound form between 1931 and 1934, has been a tremendous boon to recreation.¹² The Galveston groins, built in the 1930s to prevent beach erosion and protect the seawall, have further enriched recreational resources, furnishing easily accessible fishing areas and a haven for small fish and crustaceans. Quite incidentally, such structures increase the number of habitats conducive to marine life.



Rehabilitation of Galveston groins, 1969

Beach erosion has long commanded the Galveston District's attention. At first, federal interest in this problem was limited to protection of federal property and improvements for navigation. After 1930, it grew to encompass not only federally owned property, but also publicly owned shores and, eventually, even private property when the protection would result in public benefits.¹³

Until recently, when beach erosion acquired greater prominence in the light of widespread conservation concern, the Galveston groin system was the district's sole beach erosion project. Now, operations move along on a new and different project, authorized to replenish North Beach on Corpus Christi Bay. In 1868, this beach shoreline extended bayward as much as several hundred feet. Relatively steady regression has occurred since 1882, reducing the 1.4-mile-long beach to an average width of 20 feet. As the beach gradually disappeared, so did the tourists who had formerly flocked to its once popular seaside resort area.¹⁴

The restoration project will create a beach area of 1.8 million square feet with a level berm 100 feet wide and 3 feet above mean sea level. The bayward slope will extend the shorefront to a total of 300 feet. Material for the base of the construction will be excavated from a borrow pit in Corpus Christi Bay, thereby providing a deep pool where fish can congregate



Beach restoration in progress at North Beach on Corpus Christi Bay late in June, 1977 (Photograph by Edgar R. Cobb, Jr.)



Dramatic beach erosion at Surfside is now being studied by the Corps. Note road washed out behind houses where beach has already disappeared.

during cold spells. Beach cover material is being obtained from a commercial sand source on the Nueces River. Periodic nourishment of the beach will be provided initially by the federal government and, after ten years, taken over by local interests.

A Delicate Balance

A bit of humor, attributed to the unlikely source of *Playboy* magazine, has recently enjoyed widespread popularity. Pointing up how pervasive national awareness of environmental concerns has become, the story consists of a conversation between God and Moses. The Lord tells Moses He has both good news and bad news for him. The good news, He tells Moses, is that plagues will smite the Egyptian oppressors, the Nile will turn to blood, frogs and locusts will cover the fields, gnats and flies will infest the Pharaoh's people, and hail and darkness will visit punishment upon the land of Egypt. "Then," promises the Lord, "I shall lead the children of Israel forth, parting the waters of the Red Sea so they may cross, and strewing the desert with manna so they may eat." Moses replies, "O Lord, that's wonderful; but tell me, what's the bad news?" And the Lord God responds, "It will be up to you, Moses, to write the environmental impact statement."¹⁵

In fact, the provision of the environmental impact statement (EIS) is no joking matter. Fulfilling this requirement entails considerable work for Galveston District personnel and guarantees consideration of factors that previously might not have been taken into account. Through the medium of the EIS, environmental quality takes its place beside engineering feasibility and economic efficiency as a prime criterion for future Corps projects.

When it was introduced, the EIS requirement created an awkward situation for previously authorized projects, some of which were well underway in 1970. In the Galveston District, several such projects — Wallisville Dam and Lake, a barge canal on Chocolate Bayou, and a flood-control and drainage project on Taylors Bayou — have been delayed by ramifications of the new procedure.

Wallisville serves to illustrate the difficulties that accompanied application of the National Environmental Policy Act to preauthorized projects. An obvious question asked whether the law should be applied to partially completed projects in the same manner as to future projects. Another issue revolved around the proper timing for evaluation of environmental impact. One court, addressing itself to this subject, declared that an EIS ". . . ought not to be modeled upon the works of Jules Verne or H. G. Wells."¹⁶

The Wallisville plan grew out of the almost century-old navigation project providing for a channel from Trinity Bay up to Liberty. The new, multipurpose project was designed primarily to prevent saltwater intrusion, a problem fostered by the navigation channel and particularly aggravated by drought. Salinity began damaging rice crops along the Trinity River during the 1950s and led to authorization for the Wallisville project in 1962.¹⁷ Involving an earthen dam, reservoir, and navigation lock, the project would bar salt water from the river, thereby preserving the suitability of the river water for industrial, municipal, and agricultural uses. Furthermore, the water stored in the reservoir would increase the water supply for the well-populated, highly industrial adjacent area. The impounded waters would also benefit production of freshwater fish. Four parks located on the reservoir would provide recreational areas offering access to improved sport fishing and other water activities.

Begun in 1966, Wallisville construction was moving steadily along when the National Environmental Policy Act became law. Although guidelines were still formative and constantly changing, the Corps published the Wallisville EIS on December 13, 1971. Indicative of the extent to which the public has become embroiled in civil works during this decade, three environmental groups, a sportsmen's club, a commercial shrimp association, and two private citizens joined together in opposing the project. Taking their collective grievances to the federal district court in Houston, they obtained a decision enjoining the project, then 72 percent complete, on February 16, 1973.

The Wallisville case epitomized the monumental difficulties of satisfying multiple agencies and interests. The seven plaintiffs brought suit against the secretary of the army, the chief of engineers, and the Galveston District engineer. Listed as Defendants by Intervention were the Trinity River Authority, the cities of Houston, Fort Worth, and Dallas, and the Coastal Industrial Water Authority of Texas.¹⁸

The most salient objection to the project focused on that portion of the estuary above the dam where salty marshes, capable of supporting marine organisms, would be lost to freshwater storage. As this change would impair the saltwater habitat, decreased productivity of such valuable shellfish as brown and white shrimp and blue crabs as well as certain other species of fish would be anticipated.¹⁹

A circuit court of appeals at New Orleans reversed and remanded the district court decision on August 26, 1974. Meanwhile, Wallisville construction remains in abeyance until a supplemental EIS is submitted to the district court judge.

Although this brief discussion of Wallisville barely skims the surface of the many issues involved, it offers a sample of the enormous complexities — scientific, political, and legal — that must be overcome in integrating economic and environmental objectives.

Still another aspect of the National Environmental Policy Act that must be satisfied reaches beyond the limitations of the natural environment. The Corps of Engineers and other agencies engaged in civil construction must include in their environmental statements the anticipated impact upon cultural resources, especially archaeological and historic sites that may be affected by proposed projects. This entails not only initial reconnaissance to locate and identify potentially valuable sites, but also more intensive investigation to evaluate their significance and eligibility for preservation. Should they offer promise of adding to existing knowledge, they must be further scrutinized with a view toward future salvaging or preservation.

Within the Galveston District boundaries reside many clues to early habitation of the Texas coastal region. Ceramic, bone, and stone artifacts reveal cultural changes of the aboriginal Indian inhabitants and the apparently limited influence of their interaction with the Europeans who slowly arrived over the years after Cabeza de Vaca was cast ashore on Galveston Island in 1528. Shell and earth middens (refuse heaps) afford further insight into former life-styles by tracing the evolution of subsistence patterns.²⁰ Studies to assess the cultural impact of proposed projects have yielded a rich assortment of historic sites and archaeological artifacts, stimulating exploration and enhancing knowledge of these primitive societies.

Bicentennial awareness has heightened our sense of history and our appreciation of these cultural landmarks. Also, it has encouraged the Galveston army engineers to review their own role in the emergence of the Texas Gulf Coast. Their engineering accomplishments represent a vital contribution to development of this important part of the United States, a section blessed with valuable natural resources and offering tremendous residential, industrial, and recreational potential. The Galveston District has facilitated and supported regional growth, shouldering correspondingly greater responsibilities for improvement, maintenance, and protection within its boundaries.

Review of past achievements leads to reflection of the present and speculation as to what may lie ahead. Studies of superports 70 feet deep provide just one impressive indication of how significantly times, technology, and the coastal area have changed since the first improvements were undertaken by army engineers. The trend toward urbanization as this

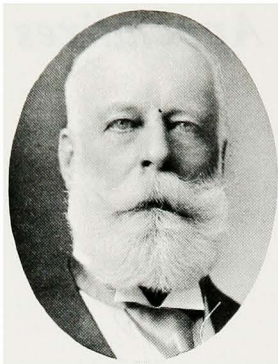
region gains popularity may be expected to introduce another host of problems, disturbing the delicate balance between civilization and nature. Whatever challenges may arise, the men and women of the Galveston District can be expected to face the future with the same spirit of preparedness and ingenuity that has prevailed throughout their proud history.

Notes to Chapter 10

- ¹. 42 U.S.C.A. §§ 4331-4347 (1970).
- ². 33 U.S.C.A. §§ 401-418 (1970); Albert E. Cowdrey, "Pioneering Environmental Law: The Army Corps of Engineers and the Refuse Act," *Pacific Historical Review* 44 (August 1975): 341-43.
- ³. Telephone interview with Glen Egan, September 1975; Cowdrey, "Pioneering Environmental Law," p. 344.
- ⁴. Rivers and Harbors Act of March 3, 1899, 33 U.S.C.A. §§ 401-418 (1970); Exec. Order No. 11574 (1970); Engineer Regulation 1145-2-321 dated 7 April 1971; 33 U.S.C.A. § 1151 et seq. (1972); Permits for Activities in Navigable Waters or Ocean Waters 33 C.F.R. § 209.120 (1975).
- ⁵. E. O. Gangstad, "Integrated Control of Alligator Weed and Water Hyacinth in Texas," in *Aquatic Plant Control Program, Technical Report 9* (Vicksburg: U.S. Army Engineer Waterways Experiment Station, 1975), p. 1; *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1906* (Washington, D.C.: Government Printing Office, 1906), pp. 1324-25 (hereafter cited as *ARCE*, followed by date of fiscal year covered in report); Rivers and Harbors Act of March 3, 1905, ch. 1482, 33 Stat. 1117.
- ⁶. *ARCE*, 1908, p. 1521.
- ⁷. *Final Environmental Statement, Aquatic Plant Control and Eradication Program, State of Texas* (Galveston: Corps of Engineers, 1972), pp. 7-8.
- ⁸. Gangstad, "Integrated Control," p. 1; *Final Environmental Statement*, pp. 1-3.
- ⁹. *Final Environmental Statement*, pp. 3-6; Flood Control Act of October 27, 1965, Pub. L. No. 89-298, 79 Stat. 1073.
- ¹⁰. *Galveston Daily News*, 27 August 1975.
- ¹¹. *Houston Post*, 10 August 1975.
- ¹². Rivers and Harbors Act of March 4, 1913, ch. 144, 37 Stat. 801; Rivers and Harbors Act of July 3, 1930, ch. 847, 46 Stat. 918.
- ¹³. Rivers and Harbors Act of July 3, 1930, ch. 847, 46 Stat. 918; Act of August 13, 1946, ch. 960, 60 Stat. 1056; Act of July 28, 1956, ch. 768, 70 Stat. 702.
- ¹⁴. Resolutions adopted by House Public Works Committee on 15 December 1970 and by Senate Public Works Committee on 17 December 1970 in accordance with section 201 of Flood Control Act of 1965; *Revised Final Environmental Statement, Corpus Christi Beach, Texas (Restoration Project)* (Galveston: Corps of Engineers, 1975), p. 7.
- ¹⁵. *Houston Post*, 2 March 1975.
- ¹⁶. *Scientists' Institute for Public Information, Inc. v. Atomic Energy Commission*, 481 F. 2d 1079 (D.C. Cir. 1973).
- ¹⁷. Rivers and Harbors Act of October 23, 1962, Pub. L. No. 87-874, 76 Stat. 1173.
- ¹⁸. *Sierra Club v. Froehleke*, 359 F. Supp. 1289 (S.D. Tex. 1973).
- ¹⁹. *Ibid.*
- ²⁰. Kathleen Gilmore, *Cultural Variation on the Texas Coast: Analysis of an Aboriginal Shell Midden, Wallisville Reservoir, Texas*, Texas Archeological Survey, Research Report no. 44 (Austin: University of Texas, 1974), pp. ii, 1-6 ff.

Appendixes

- A. Galveston District Engineers
- B. Staff Conferences
- C. A Brief History of Galveston District Headquarters
- D. Galveston District Organization Chart
- E. Cargo Movement through Texas Coast Jetty Channels



Brig. Gen. S. M. Mansfield
Jan. 9, 1880-Nov. 22, 1886



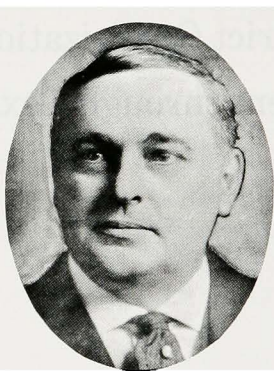
Maj. Gen. O. H. Ernst
Nov. 22, 1886-Nov. 2, 1889



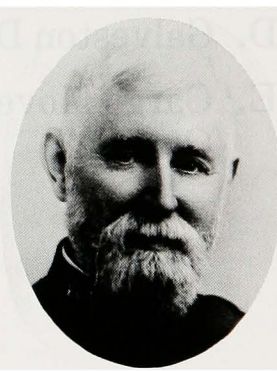
Maj. Charles J. Allen
Nov. 20, 1889-Feb. 8, 1893



Col. Alexander M. Miller
March 21, 1893-Sept. 10, 1897



Col. Charles S. Riché
Sept. 10, 1897-June 16, 1898
Nov. 10, 1898-May 29, 1903
Aug. 12, 1912-July 22, 1916



Col. James B. Quinn
June 16, 1898-Nov. 10, 1898



Lt. Gen. Edgar Jadwin
May 29, 1903-June 10, 1907
(Chief of Engineers,
June 1926-Aug. 1929)



Col. J. C. Oakes
June 10, 1907-Feb. 21, 1910



Brig. Gen. G. P. Howell
Feb. 21, 1910-July 26, 1911



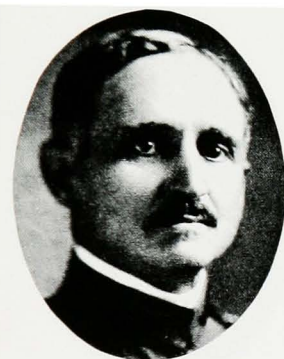
Col. E. I. Brown
July 26, 1911-Aug. 12, 1912



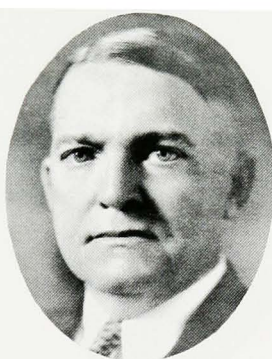
Col. E. N. Johnston
July 22, 1916-Sept. 13, 1917



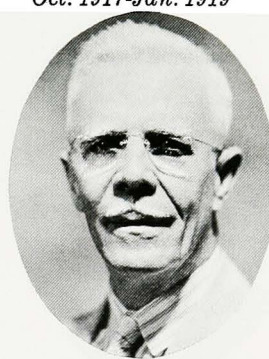
Raphael C. Smead
(Maj. C.E.-ORC)
Oct. 1917-Jan. 1919



Col. Spencer Cosby
Jan. 24, 1919-May 22, 1920



Col. L. M. Adams
May 22, 1920-May 25, 1924



Col. B. B. Browne
May 25, 1924-July 27, 1924



Maj. Gen. Julian L. Schley
July 27, 1924-June 25, 1928
(Chief of Engineers,
Oct. 1937-Oct. 1941)



Col. Milo P. Fox
June 25, 1928-July 7, 1933



Brig. Gen. E. H. Marks
July 7, 1933-July 28, 1937



Col. F. S. Besson
July 28, 1937-Jan. 13, 1941



Col. L. H. Hewitt
Jan. 13, 1941-Dec. 3, 1942



Col. Wilson G. Saville
Dec. 3, 1942-Oct. 31, 1943



Col. J. H. Anderson
Nov. 8, 1943-July 8, 1944



Col. H. M. Yost
July 6, 1944-June 15, 1945



Col. David W. Griffiths
July 8, 1945-July 23, 1947



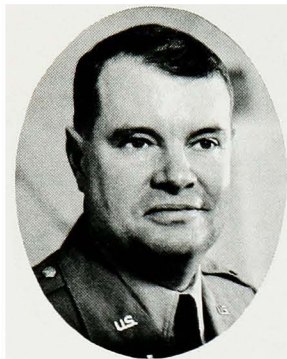
Maj. Gen. B. L. Robinson
Aug. 13, 1947-June 21, 1949



Maj. Gen. E. I. Davis
June 22, 1949-Oct. 8, 1951



Col. J. D. Lang
Oct. 22, 1951-July 31, 1954



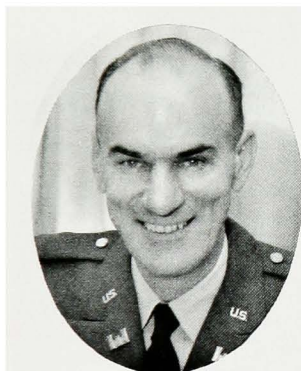
Col. W. P. McCrone
Aug. 23, 1954-Aug. 23, 1957



Col. E. A. Hansen
Aug. 24, 1957-July 31, 1960



Col. H. C. Brown
Aug. 1, 1960-Oct. 13, 1961



Col. J. S. Maxwell
Oct. 14, 1961-July 9, 1964



Col. J. E. Unverferth
July 10, 1964-June 30, 1967



Col. Franklin B. Moon
July 13, 1967-July 31, 1970



Col. Nolan C. Rhodes
Aug. 1, 1970-June 29, 1973

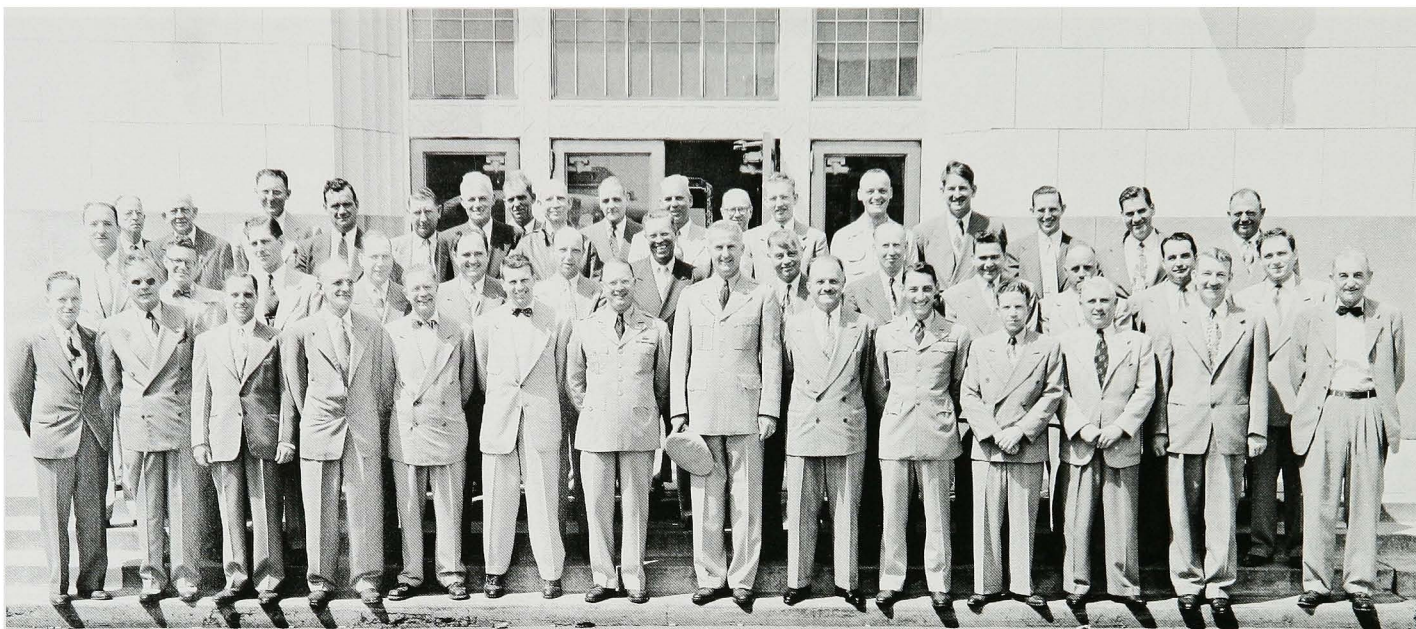


Col. Don S. McCoy
June 30, 1973-May 31, 1976



Col. Jon C. Vanden Bosch
June 1, 1976-





CORPS OF ENGINEERS U.S. ARMY
STAFF CONFERENCE GALVESTON DISTRICT 10 APRIL 1950

FRONT ROW

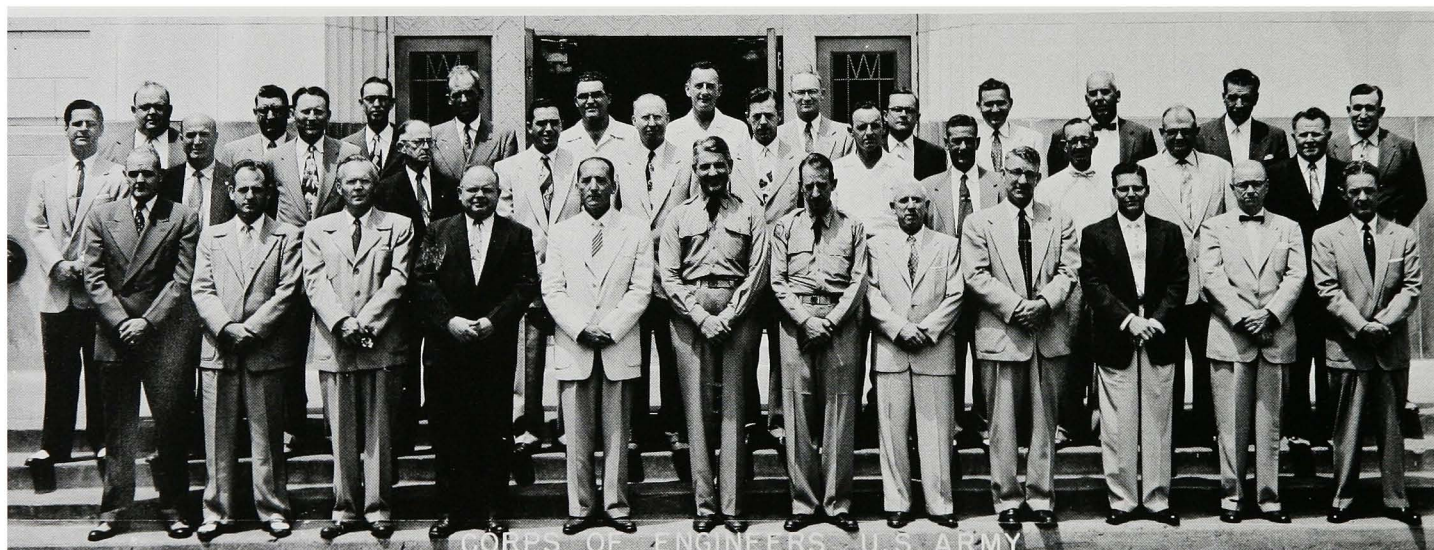
G. F. Egan, R. Wodemeyer, M. A. Dillingham, O. H. Wright, N. H. Jensen, Lt. Col. W. J. Parly, Lt. Col. G. D. McDowell, Lt. Col. E. I. Davis, Lt. Col. W. P. Jones, Capt. J. A. Belts, R. M. Latham, R. A. Crossman, W. E. Laird, T. W. Forman

SECOND ROW

K. M. Reedy, W. L. Black, C. E. Rylander, C. P. Ferbrache, A. F. Brown, G. J. Kaelin, J. J. Russell, M. Hoima, T. R. Jacobson, E. L. Embrey, F. W. Johnson, K. M. Smith, A. Rosenthal

THIRD ROW

A. E. Lingenfelter, D. B. Jew, C. F. Bach, O. L. Meyers, I. J. Dixon, F. O. Schaefer, J. R. Simpson, Col. R. Benham, W. C. Ralligan, N. W. Brown, H. E. Schmidt, J. H. Lyle, C. H. Beardsley, W. A. Bloch, M. R. Royer, F. W. Drummond, H. L. Sisson



CORPS OF ENGINEERS, U.S. ARMY

STAFF CONFERENCE

GALVESTON DISTRICT
FRONT ROW

27 JULY 1954

W.C. Rettiger, J.A. Brigrance, R. Wedemeyer, O.A. Scovill, K. Heagy, Col. J.D. Lang, D.E., Lt. Col. C.T. Ricketts,
R.A. Crossman, W.E. Laird, W.L. Black, H.E. Schmidt, T.W. Elam.

SECOND ROW

G.J. Micheletti, T.P. Snyder, C.F. Baehr, A.E. Lingenfelter, R. Sewell, T.R. Jacobson, F.J. Hubert, Jr., C.G. Pollard,
H.E. Fry, Jr., E.R. Robbins, H.L. Sisson, N.J. Papp.

THIRD ROW

L.P. Bailey, I.J. Diver, A.J. Wilson, Jr., J.R. Simpson, H.L. Heald, R.E. Pinkley, C.E. McQuain, R.W. Austin,
E.L. Embrey, N.W. Brown, J.A. Dunlap, D.L. Turpin.



U. S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
Galveston, Texas

RESIDENT ENGINEERS CONFERENCE

2 - 3 DECEMBER 1958

FIRST ROW

N. J. Papp, H. G. Vela, T. W. Elam, H. E. Fry, Jr., J. A. Brigance, Major E. E. Lane, Jr., Colonel E. A. Hansen, J. W. Stewart, S. McKnight, W. G. Moody, E. R. Robbins, B. E. Stephenson

SECOND ROW

G. J. Micheletti, N. W. Brown, J. R. Simpson, V. C. Keesecker, D. L. Turpin, C. E. McQuain, W. E. Laird, E. D. McGehee, H. L. Sisson, S. G. Garrett, John Bember

THIRD ROW

E. Carter, A. J. Wilson, Jr., T. R. Jacobson, C. L. Pawlik, J. A. Dunlap, W. C. Rettiger, C. F. Baehr, H. L. Richter, Mrs. D. L. Muecke, J. H. King, F. L. Bertling, B. M. Hutchison

A Brief History of Galveston District Headquarters

The subject of historic landmarks suggests one final topic that belongs in the Galveston District's story. As the workload and personnel strength of the district have fluctuated over the past ninety-five years, so has grown the need for suitable headquarters. Following the makeshift facilities at Fort Point during the gabion jetty project, the Galveston engineers have maintained offices in some of the city's more distinctive edifices.

The structure that housed the first district offices was erected in stages between 1855 and 1859. Of Greek Revival architectural design, featuring granite columns and topped with a brick cornice, the pretentious Hendley Building was constructed with "the permanency of Corinth." First commercial building in Galveston, it has figured prominently in the history of the city. Throughout the Civil War, an observatory to monitor the Union blockade in the harbor was maintained on the roof of the corner section in which Major Mansfield later occupied space after his arrival in 1880. A focal point in the Battle of Galveston in 1863, when the Confederates regained control of the city, the Hendley Building still bears scars of the barrage of artillery during the encounter.¹

By 1888, the Galveston Engineer Office had vacated the suite in the Hendley Building and moved to the Alvey Building, 319 Twenty-second

Hendley Building (Rosenberg Library)





Post Office Building (Photograph by Ken Bonham)

Street, on the northwest corner of Market and Twenty-second. No longer standing, this building housed the engineer offices for almost a decade.

The 1896-97 *City Directory* lists the engineers at a third address, the Telephone Building, located on the northwest corner of Twenty-second and Church streets. These quarters were occupied by the Galveston Engineer Office through the turn of the century.²

In 1895, the Galveston Chamber of Commerce had contemplated construction of "a modern eight story office building" on the northeast corner of Tremont and Postoffice streets. In a letter addressed to Maj. A. M. Miller, the chamber touted the future Trust Building, concluding:

I send you this information knowing that you and the other gentlemen of the service fully realize what such accommodations as those proposed mean to the occupants, and hoping that by so doing I will be furthering the desires of our Chamber toward securing the cream of the office renters of the city for a building that will undoubtedly, in every way fully supply their necessities and desires.³

The "cream of the office renters" were ensconced in the new Trust Building by the time the 1901-02 *City Directory* was published. This building headquartered the Galveston engineers for approximately the next thirty-seven years.⁴

By 1938, the district engineer had relocated his office to the third floor of the new U.S. Post Office Building on Twenty-fifth Street. With the personnel force growing to meet the needs of expanding flood-control work, supplementary space was obtained in the Customs House on Strand and in the Trust Building by the end of the year.

Space demands mushroomed with the onset of military work occasioned by World War II. The early 1940s found district personnel scattered throughout the Post Office Building, the Trust Building, the Customs House, the old Federal Building at Twentieth and Postoffice, and the Santa Fe Building. In 1941, the district began occupancy of this railroad terminal building, a fine example of the art deco style of the twenties and thirties. By 1944, the district engineer was installed there and district headquarters were consolidated into the Santa Fe Building, the Post Office Building, and the Customs House. This decentralized arrangement endured until April, 1974, when the Galveston District moved into its own building for the first time.

Santa Fe Building (Rosenberg Library)





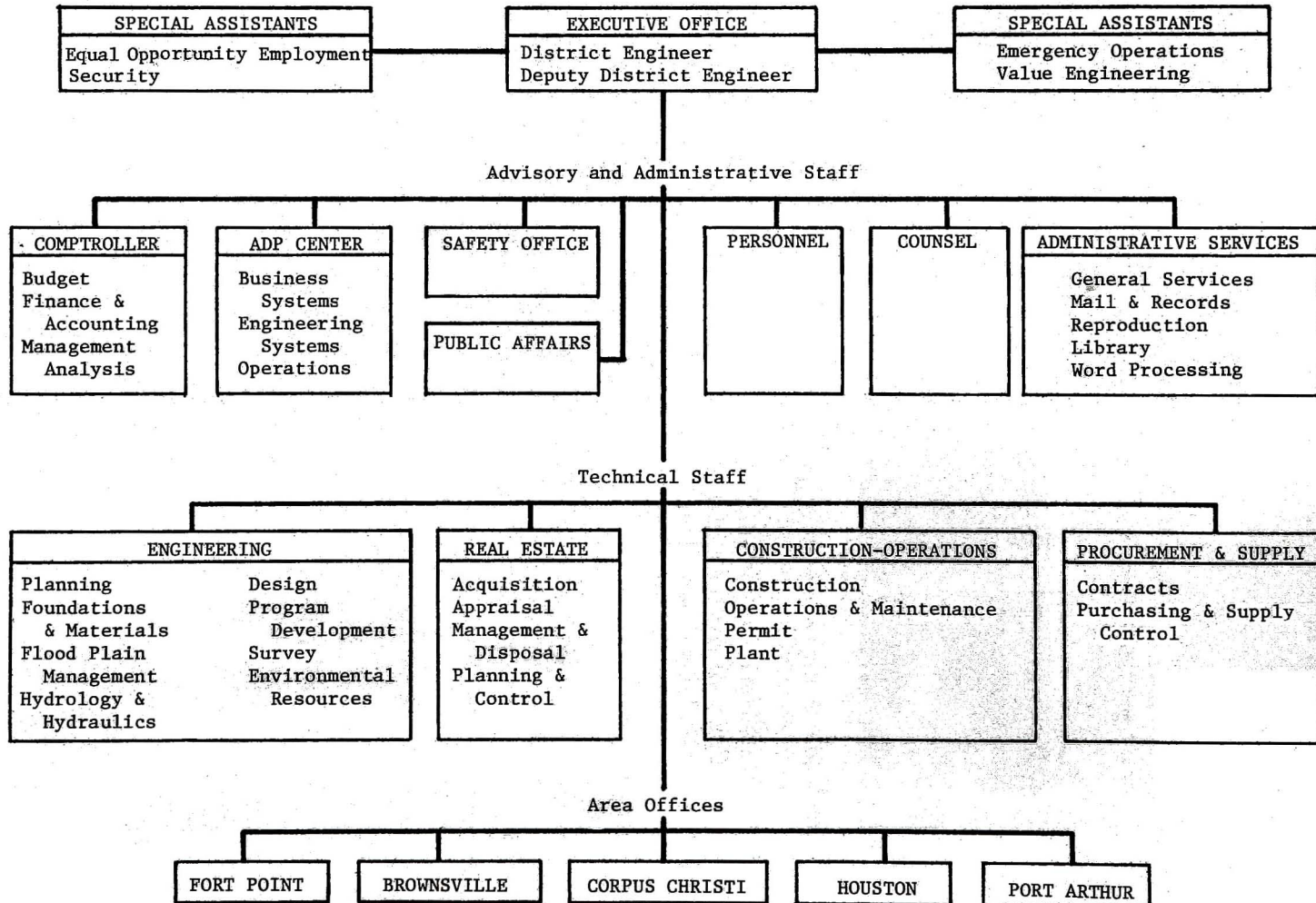
Essayons Building (Photograph by Ken Bonham)

Located on reclaimed land at the eastern end of the island, not far from Fort Point where the district's history began, the contemporary Essayons Building is named for the time-honored Corps of Engineers motto — Let us try! — a throwback to the eighteenth century days when an engineering education could be obtained only in France. In this single-story concrete structure, Galveston District personnel were reunited under one roof for the first time since 1938.

Settling into the Essayons Building, the district made plans to celebrate the two-hundredth birthday of the Corps of Engineers. Commemorating this event, ceremonies were held and a plaque and historical marker were placed on the Hendley Building on June 16, 1975. Among other activities of the festive Bicentennial Week was an open house in the new headquarters featuring guided tours, exhibits of engineering tools and equipment, environmental and historical displays, boat trips through Galveston Harbor, a band concert, and many other attractions. The open house offered a microcosmic taste of the manifold projects that comprise the work of the district.

1. Howard Barnstone, *The Galveston That Was* (Houston: Museum of Fine Arts, 1966), pp. 29-36.
2. *General Directory of the City of Galveston 1896-1897* (Galveston: Morrison & Fourmy, 1896), p. 8.
3. C. H. McMaster to Miller, 26 October 1895, File no. 206-09, Doc. 41, Correspondence 1897-1943, Galveston District Installation Historical Files.
4. *General Directory of the City of Galveston 1901-1902* (Galveston: Morrison & Fourmy, 1901), p. 26.

Galveston District Organization Chart



Comparative Statement of Cargo Movement Through Texas Coast Jetty Channels
(Short Tons)

| Calendar Year | SABINE PASS | GALVESTON | FREEPORT | ARANSAS PASS | BRAZOS ISLAND | MATAGORDA | GRAND TOTAL |
|------------------|--|---|------------------------------------|---|--|--|-------------|
| | Serves Port of: Port Arthur, Beaumont, Orange, & Sabine Pass | Serves Ports of: Galveston, Houston, & Texas City | Serves Port of: Freeport Harbor | Serves Ports of: Corpus Christi & Harbor Island | Serves Ports of: Brownsville & Port Isabel | Serves Ports of: Point Comfort & Port Lavaca | |
| 1941 | 35,893,514 | 31,409,997 | 234,068 | 13,748,151 | 351,658 | - | 81,637,388 |
| 1942 | 13,522,709 | 14,470,680 | 60,962 | 6,398,867 | 236,012 | - | 34,689,230 |
| 1943 | 7,944,626 | 10,154,430 | - | 6,573,388 | 175,462 | - | 24,847,906 |
| 1944 | 8,926,866 | 11,821,777 | 150,086 | 8,133,034 | 398,981 | - | 29,430,744 |
| 1945 | 18,835,708 | 22,543,364 | 370,097 | 11,103,465 | 853,186 | - | 53,705,820 |
| 1946 | 36,475,390 | 38,002,035 | 109,934 | 17,019,786 | 1,567,136 | - | 93,174,281 |
| 1947 | 38,663,489 | 37,138,815 | 218,454 | 19,486,119 | 1,499,400 | - | 97,006,277 |
| 1948 | 40,171,263 | 39,857,875 | 484,570 | 18,463,828 | 1,550,223 | - | 100,527,759 |
| 1949 | 37,288,644 | 38,468,474 | 395,791 | 15,588,394 | 1,162,142 | - | 92,903,445 |
| 1950 | 34,107,818 | 41,368,635 | 1,076,410 | 17,776,119 | 1,020,245 | - | 95,349,227 |
| 1951 | 38,026,440 | 45,263,765 | 1,361,760 | 20,469,133 | 1,395,349 | - | 106,516,447 |
| 1952 | 34,872,308 | 46,004,489 | 2,099,859 | 18,213,792 | 1,179,290 | - | 102,369,738 |
| 1953 | 37,695,109 | 40,663,963 | 2,283,870 | 18,984,145 | 1,376,993 | - | 101,004,080 |
| 1954 | 36,692,329 | 40,042,826 | 1,555,083 | 19,763,079 | 1,328,835 | - | 99,382,152 |
| 1955 | 38,532,129 | 43,630,409 | 2,496,972 | 21,078,104 | 1,307,325 | - | 107,044,939 |
| 1956 | 42,671,800 | 48,741,187 | 2,991,551 | 22,101,657 | 1,320,512 | - | 117,826,707 |
| 1957 | 40,321,329 | 49,973,739 | 3,156,219 | 19,686,530 | 1,094,515 | - | 114,232,332 |
| 1958 | 39,342,147 | 49,944,477 | 2,468,441 | 17,720,937 | 996,187 | - | 110,472,189 |
| 1959 | 39,615,843 | 51,437,248 | 2,333,844 | 19,966,480 | 1,059,518 | - | 114,412,933 |
| 1960 | 44,165,944 | 50,136,546 | 2,138,915 | 19,634,763 | 958,242 | - | 117,034,410 |
| 1961 | 42,417,867 | 50,253,086 | 2,395,323 | 20,480,796 | 3,644,340 | - | 119,191,412 |
| 1962 | 42,312,844 | 50,795,165 | 2,581,842 | 20,948,773 | 4,159,068 | - | 120,797,692 |
| 1963 | 46,773,034 | 47,281,520 | 2,469,938 | 21,642,010 | 3,887,983 | - | 122,054,485 |
| 1964 | 44,483,630 | 48,497,868 | 2,843,901 | 21,523,372 | 4,023,472 | - | 121,372,243 |
| 1965 | 42,667,125 | 46,843,044 | 2,236,178 | 21,340,283 | 4,030,121 | 776,149 | 117,892,900 |
| 1966 | 43,226,793 | 45,661,564 | 2,162,618 | 22,228,505 | 3,919,373 | 2,877,923 | 120,076,776 |
| 1967 | 37,730,107 | 41,137,933 | 2,091,081 | 22,725,856 | 4,444,724 | 3,223,918 | 111,353,619 |
| 1968 | 35,517,026 | 43,087,719 | 2,193,043 | 21,127,607 | 4,081,551 | 2,914,432 | 108,921,378 |
| 1969 | 32,709,561 | 39,065,331 | 2,666,275 | 21,983,514 | 4,015,255 | 3,472,840 | 103,912,776 |
| 1970 | 35,812,329 | 48,699,234 | 2,291,245 | 24,200,588 | 3,764,402 | 3,275,140 | 118,042,938 |
| 1971 | 37,121,446 | 52,941,700 | 2,600,434 | 21,454,253 | 3,364,750 | 3,495,151 | 120,977,734 |
| 1972 | 37,664,604 | 54,566,980 | 3,200,380 | 18,786,675 | 2,364,685 | 3,657,179 | 120,240,503 |
| 1973 | 44,765,793 | 74,075,134 | 4,896,355 | 21,441,016 | 4,643,186 | 3,441,647 | 153,263,131 |
| 1974 | 45,950,018 | 74,891,712 | 5,200,449 | 27,168,884 | 1,077,903 | 4,247,237 | 158,536,203 |
| 1975 | 41,279,434 | 77,961,542 | 5,482,364 | 33,976,087 | 1,664,206 | 3,547,998 | 163,911,631 |

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Bibliographic Note

Many sources used to construct the Galveston District history were available within the district's records holding area, library, and working files. The Rosenberg Library in Galveston provided more general, background materials.

Particularly valuable were the *Annual Reports of the Chief of Engineers* and the Congressional documents relating to the various projects undertaken by the Galveston engineers. Originally, the *Annual Reports* were published as Congressional documents. After 1866, they began to be printed and bound separately to form the series that has continued to present times.

Where documentation was not available, personal interviews served to fill in the gaps. Notes of these interviews together with materials collected in the course of preparing this history have been deposited in the Galveston District Installation Historical Files.

Wherever possible, legal citations in the notes to each chapter direct the reader to the *United States Statutes at Large* and the *United States Code Annotated*; however, all rivers and harbors acts prior to 1938 may be conveniently found also in the three-volume compilation, *Laws of the United States Relating to the Improvement of Rivers and Harbors from August 11, 1790 to June 29, 1938*.

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